

# HP StorageWorks

## 2000 G2 Modular Smart Array

### Reference Guide

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# About this guide

This guide provides information about managing an 2000 G2 Modular Smart Array storage system by using its web interface, Storage Management Utility (SMU).

## Intended audience

This guide is intended for storage system administrators.

## Prerequisites

Prerequisites for using this product include knowledge of:

- Network administration
- Storage system configuration
- Storage area network (SAN) management and direct attach storage (DAS)
- Fibre Channel, Serial Attached SCSI (SAS), Internet SCSI (iSCSI), and Ethernet protocols

## Related documentation

In addition to this guide, please refer to other documents for this product:

- HP StorageWorks MSA2000 G2 Installation Instructions
- HP StorageWorks 2000 G2 Modular Smart Array Cable Configuration Guide
- HP StorageWorks 2312fc and 2324fc User's Guide
- HP StorageWorks 2000i G2 Modular Smart Array User's Guide
- HP StorageWorks 2000sa G2 Modular Smart Array User's Guide
- HP StorageWorks 2000 G2 Modular Smart Array CLI Reference Guide
- Online help for HP StorageWorks 2000 G2 Modular Smart Array management interfaces

These and other HP documents can be found on the HP documents web site: <http://www.hp.com/support/>.

## Document conventions and symbols

**Table 1** Document conventions

Convention	Element
Medium blue text: <a href="#">Figure 1</a>	Cross-reference links and e-mail addresses
Medium blue, underlined text ( <a href="http://www.hp.com">http://www.hp.com</a> )	Web site addresses
<b>Bold font</b>	<ul style="list-style-type: none"><li>• Key names</li><li>• Text typed into a GUI element, such as into a box</li><li>• GUI elements that are clicked or selected, such as menu and list items, buttons, and check boxes</li></ul>
<i>Italics font</i>	Text emphasis
Monospace font	<ul style="list-style-type: none"><li>• File and directory names</li><li>• System output</li><li>• Code</li><li>• Text typed at the command-line</li></ul>
<i>Monospace, italic font</i>	<ul style="list-style-type: none"><li>• Code variables</li><li>• Command-line variables</li></ul>
<b>Monospace, bold font</b>	Emphasis of file and directory names, system output, code, and text typed at the command line

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△ **CAUTION:** Indicates that failure to follow directions could result in damage to equipment or data.

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📖 **NOTE:** Provides additional information.

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💡 **TIP:** Provides helpful hints and shortcuts.

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## HP technical support

Telephone numbers for worldwide technical support are listed on the HP support web site:  
<http://www.hp.com/support/>.

Collect the following information before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

For continuous quality improvement, calls may be recorded or monitored.

## Product warranties

For information about HP StorageWorks product warranties, see the warranty information website:

<http://www.hp.com/go/storagewarranty>

## Subscription service

HP strongly recommends that customers sign up online using the Subscriber's choice web site:  
<http://www.hp.com/go/e-updates>.

- Subscribing to this service provides you with e-mail updates on the latest product enhancements, newest versions of drivers, and firmware documentation updates as well as instant access to numerous other product resources.
- After signing up, you can quickly locate your products by selecting **Business support** and then **Storage** under Product Category.

## HP web sites

For other product information, see the following HP web sites:

- <http://www.hp.com>
- <http://www.hp.com/go/msa>
- <http://www.hp.com/go/storage>
- <http://www.hp.com/support/>
- [http://www.hp.com/service\\_locator](http://www.hp.com/service_locator)
- <http://www.docs.hp.com>

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# 1 Getting started

Storage Management Utility (SMU) is a web-based application for configuring, monitoring, and managing the storage system.

Each controller module in the storage system contains a web server, which you access when you sign in to SMU. In a dual-controller system, you can access all functions from either controller. If one controller becomes unavailable, you can continue to manage the storage system from the partner controller.

SMU is also referred to as the web-browser interface (WBI).

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 **NOTE:** It is possible to upgrade an MSA2000 storage system by replacing its controllers with MSA2000 G2 controllers, which use the version of SMU described in this guide. For upgrade information go to [www.hp.com/go/msa2000fc](http://www.hp.com/go/msa2000fc), click Resource Library, and view the PDF "Upgrading the HP StorageWorks MSA2000fc to the next generation."

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## Configuring and provisioning a new storage system

To configure and provision a storage system for the first time:

1. Configure your web browser for SMU and sign in, as described in [Browser setup](#) and [Signing in](#) below.
2. Set the system date and time, as described in [Changing the system date and time](#) on page 36.
3. Use the Configuration Wizard to configure other system settings, as described in [Using the Configuration Wizard](#) on page 29.
4. Use the Provisioning Wizard to create a virtual disk (*vdisk*) containing storage volumes, and optionally to map the volumes to hosts, as described in [Using the Provisioning Wizard](#) on page 45.
5. If you mapped volumes to hosts then verify the mappings by mounting the volumes from each host and performing simple read/write tests to the volumes.
6. Verify that controller modules and expansion modules have the latest firmware, as described in [Viewing information about the system](#) on page 67 and [Updating firmware](#) on page 59.

You can then make additional configuration and provisioning changes and view system status, as described in later chapters of this guide.

### Browser setup

- Your browser must be Mozilla Firefox 1.5 or Microsoft Internet Explorer 6, or later. For better performance, use Firefox or Internet Explorer 7 or later.
- To see the help window, you must enable pop-up windows.
- To optimize the display, use a color monitor and set its color quality to the highest setting.
- To navigate beyond the Sign In page (with a valid user account):
  - Set the browser's local-intranet security option to medium or medium-low.
  - Verify that the browser is set to allow cookies at least for the IP addresses of the storage-system network ports.

### Signing in

To sign in:

1. In the web browser's address field, type the IP address of a controller network port and press **Enter**. The SMU Sign In page is displayed. If the Sign In page does not display, verify that you have entered the correct IP address.
2. On the Sign In page, enter the name and password of a configured user. If you are logging in to SMU for the first time, the Language field displays `user setting` or `English`, either of which results in English.

Language preferences can be configured for the system and for individual users.

- Click **Sign In**. If the system is available, the System Overview page is displayed; otherwise, a message indicates that the system is unavailable.




## Tips for signing in and signing out

- Do not include a leading zero in an IP address. For example, enter 10.1.4.6 not 10.1.4.06.
- Each user has a Monitor or Manage access level, as described in [About user accounts](#) on page 15. Multiple monitor and manage users can be signed in to each controller simultaneously.
- For each active SMU session an identifier is stored in the browser. Depending on how your browser treats this session identifier, you might be able to run multiple independent sessions simultaneously. Each instance of Internet Explorer can run a separate SMU session; however, all instances of Firefox share the same session.
- If you end a SMU session without clicking the Sign Out link near the top of the SMU window, the session automatically ends when the user's automatic sign-out time expires. If this preference is set to Never, the session ends after 9999 minutes.

## Tips for using the main window



- The Configuration View panel displays logical and physical components of the storage system. To perform a task, select the component to act on and then either:
  - Right-click to display a context menu and select the task to perform. This is the method that help topics describe.
  - Click a task category in the main panel and select the task to perform.
- The System Status panel shows how many events of each severity have occurred in the system. To view event details, click a severity icon.
- Many tables can be sorted by a specific column. To do so, click the column heading to sort low to high; click again to sort high to low.
- Do not use the browser's Back, Forward, Reload, or Refresh buttons. SMU is essentially a single page that is automatically updated to show current data; you do not need to refresh it.
- An asterisk (\*) identifies a required setting.
- The icon in the upper right corner of the main window shows the status of communication between SMU, the Management Controller (MC), and the Storage Controller (SC), as described in the following table.

**Table 2** SMU communication status icons

Icon	Meaning
	SMU can communicate with the Management Controller, which can communicate with the Storage Controller.
	SMU <i>cannot</i> communicate with the Management Controller.
	SMU can communicate with the Management Controller, which <i>cannot</i> communicate with the Storage Controller.

- Below the communication status icon, a timer shows how long the session can be idle until you are automatically signed out. This timer resets after each action you perform. One minute before automatic sign-out you are prompted to continue using SMU. The timer does not appear if the current user's Auto Sign Out preference is set to Never.
- If a SMU session is active on a controller and the controller is power cycled or is forced offline by the partner controller or certain other events occur, the session might hang. SMU might say that it is "Connecting" but stop responding, or the page may become blank with the browser status Done. After the controller comes back online, the session will not restart. To continue using SMU, close and reopen the browser and start a new SMU session.

## Tips for using the help window

- In the main panel, click the help icon  to display help for the last-selected item, whether it is a component in the Configuration View panel or a subpanel in the main panel.
- In the help window, click the table of contents icon  to show or hide the Contents pane.
- A help topic remains displayed until you browse to another topic in the help window, display help for a different item in the main window, or close the help window.
- If you have viewed more than one help topic, you can click the arrow icons to display the previous or next topic.

## System concepts


### About user accounts

The system provides three default user accounts and allows a maximum of 12 user accounts to be configured. Any account can be modified or removed except you cannot remove the user you are signed in as.

User accounts have these options:

- **User Name.** A user name is case sensitive and cannot already exist in the system. A name cannot include a comma, double quote, or backslash.
- **Password.** A password is case sensitive. A password cannot include a comma, double quote, or backslash. Though optional, passwords are highly recommended to ensure system security.
- **Access Level.** Select Monitor to let the user view system settings, or Manage to let the user view and change system settings.
- **User Type.** Select Standard to allow access to standard functions, or Advanced to allow access to all functions except diagnostic functions, or Diagnostic to allow access to all functions.

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 **NOTE:** This release has no functions that require Advanced or Diagnostic access; a Standard user can access all functions.


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- **WBI Access.** Allows access to the web-based management interface.
- **CLI Access.** Allows access to the command-line management interface.
- **FTP Access.** Allows access to the file transfer protocol interface, which provides a way to install firmware updates and download logs.
- **Base Preference.** The base for entry and display of storage-space sizes. In base 2, sizes are shown as powers of 2, using 1024 as a divisor for each magnitude. In base 10, sizes are shown as powers of 10, using 1000 as a divisor for each magnitude. Operating systems usually show volume size in base 2. Disk drives usually show size in base 10. Memory size is always shown in base 2.
- **Precision Preference.** The number of decimal places (1–10) for display of storage-space sizes.
- **Unit Preference.** Sets the unit for display of storage-space sizes. The Auto option lets the system determine the proper unit for a size. Based on the precision setting, if the selected unit is too large to meaningfully display a size, the system uses a smaller unit for that size.
- **Temperature Preference.** Specifies to use either the Celsius scale or the Fahrenheit scale for temperature values.
- **Auto Sign Out.** Select the amount of time that the user's session can be idle before the user is automatically signed out: 5, 15, or 30 minutes, or Never (9999 minutes). The default is 30 minutes.

- **Locale.** The user’s preferred display language, which overrides the system’s default display language. Installed language sets include Chinese-simplified, Chinese-traditional, Dutch, English, French, German, Italian, Japanese, Korean, and Spanish.

**Table 3** Settings for default users

Name	Password	Level	Type	WBI	CLI	FTP	Base	Prec.	Units	Temp.	Auto Sign Out	Locale
monitor	!monitor	Monitor	Standard	Yes	Yes	No	10	1	Auto	Celsius	30 Min.	English
manage	!manage	Manage		Yes	Yes	Yes						
ftp	!flash	Manage		No	No	Yes						

 **NOTE:** To secure the storage system, set a new password for each default user.

## About vdisks

A *vdisk* is a “virtual” disk that is composed of one or more disks, and has the combined capacity of those disks. The number of disks that a *vdisk* can contain is determined by its RAID level. All disks in a *vdisk* must be the same type (SAS or SATA, small or large form-factor). A maximum of 16 *vdisks* per controller can exist.

A *vdisk* can contain different models of disks, and disks with different capacities. For example, a *vdisk* can include a 500-GB disk and a 750-GB disk. If you mix disks with different capacities, the smallest disk determines the logical capacity of all other disks in the *vdisk*, regardless of RAID level. For example, if a RAID-0 *vdisk* contains one 500-GB disk and four 750-GB disks, the capacity of the *vdisk* is equivalent to approximately five 500-GB disks. To maximize capacity, use disks of similar size. For greatest reliability, use disks of the same size and rotational speed.

Each disk has metadata that identifies whether the disk is a member of a *vdisk*, and other members of that *vdisk*. This enables disks to be moved to different slots in a system; an entire *vdisk* to be moved to a different system; and a *vdisk* to be quarantined if a disk is detected missing.

In a single-controller system, all *vdisks* are owned by that controller. In a dual-controller system, when a *vdisk* is created the system automatically assigns the owner to balance the number of *vdisks* each controller owns; or, you can select the owner. Typically it does not matter which controller owns a *vdisk*.

In a dual-controller system, when a controller fails, the partner controller assumes temporary ownership of the failed controller's *vdisks* and resources. If the system uses a fault-tolerant cabling configuration, both controllers' LUNs become accessible through the partner.

When you create a *vdisk* you can also create volumes within it. A volume is a logical subdivision of a *vdisk*, and can be mapped to controller host ports for access by hosts. The storage system presents only volumes, not *vdisks*, to hosts.

You can create *vdisks* with or without volumes by using the Provisioning Wizard, or you can create *vdisks* manually.

## About spares

A controller automatically reconstructs a redundant (fault-tolerant) *vdisk* (RAID 1, 3, 5, 6, 10, 50) when one or more of its disks fails and a properly sized spare disk is available.

There are three types of spares:

- *Dedicated spare.* Reserved for use by a specific *vdisk* to replace a failed disk. Most secure way to provide spares for *vdisks* but expensive to reserve a spare for each *vdisk*.
- *Global spare.* Reserved for use by any redundant *vdisk* to replace a failed disk.
- *Dynamic spare.* A properly sized available disk that is automatically assigned to replace a failed disk in a redundant *vdisk*.



When a disk fails, the system looks for a dedicated spare first. If it does not find a properly sized dedicated spare, it looks for a global spare. If it does not find a properly sized global spare and the dynamic spares option is enabled, it takes any properly sized available disk. If no properly sized spares are available, reconstruction cannot start.

## About volumes

A *volume* is a logical subdivision of a vdisk, and can be mapped to controller host ports for access by hosts. This type of volume provides the storage for a file system partition you create with your operating system or third-party tools. The storage system presents only volumes, not vdisks, to hosts. A vdisk can have a maximum of 128 volumes.

You can create a vdisk that has one volume or multiple volumes.

- Single-volume vdisks work well in environments that need one large, fault-tolerant storage space for data on one host. A large database accessed by users on a single host that is used only for that application is an example.
- Multiple-volume vdisks work well when you have very large disks and you want to make the most efficient use of disk space for fault tolerance (parity and spares). For example, you could create one very large RAID-5 vdisk and dedicate one spare to the vdisk. This minimizes the amount of disk space allocated to parity and spares compared to the space required if you created five or six smaller RAID-5 vdisks. However, I/O to multiple volumes in the same vdisk can slow system performance.

When you create volumes you can specify their sizes. If the total size of a vdisk's volumes equals the size of the vdisk, you will not have any free space. Without free space, you cannot add or expand volumes. If you need to add or expand a volume in a vdisk without free space, you can delete a volume to create free space. Or, you can expand the vdisk and then either add a volume or expand a volume to use the new free space.

You can use a volume's default name or change it to identify the volume's purpose. For example, a volume used to store payroll information can be named Payroll.

You can create vdisks with volumes by using the Provisioning Wizard, or you can create volumes manually.

## About hosts

A *host* identifies an external port that the storage system is attached to. The external port may be a port in an I/O adapter in a server, or a port in a network switch. Examples of I/O adapters are FC HBAs.

The controllers automatically add hosts that have sent an `inquiry` command or a `report luns` command to the storage system. Hosts typically do this when they boot up or rescan for devices. When the command from the host occurs, the system saves the host ID. The ID for an FC or SAS host is its WWPN. The ID for an iSCSI host is typically, but not limited to, its IQN.

You must assign a name to an automatically added host to have the system retain it after a restart. Naming hosts also makes them easy to recognize for volume mapping. A maximum of 64 names can be assigned.

The Configuration View panel lists hosts by name, or if they are unnamed, by ID.

## iSCSI host security

The storage system can be protected from unauthorized access via iSCSI by enabling Challenge Handshake Authentication Protocol (CHAP). CHAP authentication occurs during an attempt by a host to login to the system. This authentication requires an identifier for the host and a shared secret between the host and the system. Optionally, the storage system can also be required to authenticate itself to the host; this is called mutual CHAP.

The host node identifier is typically, but not limited to, its IQN. A secret can have 12–16 characters.

Steps involved in enabling CHAP include:

- Decide on host node names and secrets.
- Define CHAP entries in the storage system. If the node name is a host name, then it may be useful to display the hosts that are known to the system.
- Enable CHAP on the storage system. Note that this applies to all iSCSI hosts, in order to avoid security exposures.

- Define CHAP secret in the host iSCSI initiator.
- Request host login to the storage system. The host should be displayable by the system, as well as the ports through which connections were made.

If it becomes necessary to add more hosts after CHAP is enabled, additional CHAP node names and secrets can be added. If a host attempts to login to the storage system, it will become visible to the system, even if the full login is not successful due to incompatible CHAP definitions. This information may be useful in configuring CHAP entries for new hosts. This information becomes visible when an iSCSI discovery session is established, because the storage system does not require discovery sessions to be authenticated.

## About volume mapping

Each volume has default host-access settings that are set when the volume is created; these settings are called the *default mapping*. The default mapping applies to any host that has not been explicitly mapped using different settings. *Explicit mappings* for a volume override its default mapping.


Default mapping enables all attached hosts to see a volume using a specified LUN and access permissions set by the administrator. This means that when the volume is first created, all connected hosts can immediately access the volume using the advertised default mapping settings. This behavior is expected by some operating systems, such as Microsoft Windows, which can immediately discover the volume. The advantage of a default mapping is that all connected hosts can discover the volume with no additional work by the administrator. The disadvantage is that all connected hosts can discover the volume with no restrictions. Therefore, this process is not recommended for specialized volumes such as payroll databases.

You can change a volume's default mapping, and create, modify, or delete explicit mappings. A mapping can specify read-write, read-only, or no access through one or more controller host ports to a volume. When a mapping specifies no access, the volume is *masked*. You can apply access privileges to one or more of the host ports on either controller. To maximize performance, it is recommended to map a volume to at least one host port on the controller that owns it. To sustain I/O in the event of controller failure, it is recommended to map to at least one host port on each controller.

Continuing the example of the payroll volume, it could be mapped with read-write access for the Human Resources host and be masked for all other hosts. An engineering volume could be mapped with read-write access for the Engineering host and read-only access for other departments' hosts.

A LUN identifies a mapped volume to a host. Both controllers share a set of LUNs, and any unused LUN can be assigned to a mapping; however, each LUN can only be used once per volume as its default LUN. For example, if LUN 5 is the default for Volume1, no other volume in the storage system can use LUN 5 as its default LUN. For explicit mappings, the rules differ: LUNs used in default mappings can be reused in explicit mappings for other volumes and other hosts.

---

 **TIP:** When an explicit mapping is deleted, the volume's default mapping takes effect. Therefore, it is recommended to use the same LUN for explicit mappings as for the default mapping.

---

Volume mapping settings are stored in disk metadata. If enough of the disks used by a volume are moved into a different enclosure, the volume's vdisk can be reconstructed and the mapping data is preserved.

## About volume cache options

You can set options that optimize reads and writes performed for each volume.

### Using write-back or write-through caching

---

- △ **NOTE:** Only disable write-back caching if you fully understand how the host operating system, application, and adapter move data. If used incorrectly, you might hinder system performance.
- 

You can change a volume's write-back cache setting. *Write-back* is a cache-writing strategy in which the controller receives the data to be written to disks, stores it in the memory buffer, and immediately sends the host operating system a signal that the write operation is complete, without waiting until the data is actually written to the disk. Write-back cache mirrors all of the data from one controller module cache to the other. Write-back cache improves the performance of write operations and the throughput of the controller.

When write-back cache is disabled, *write-through* becomes the cache-writing strategy. Using write-through cache, the controller writes the data to the disks before signaling the host operating system that the process is complete. Write-through cache has lower write operation and throughput performance than write-back, but it is the safer strategy, with minimum risk of data loss on power failure. However, write-through cache does not mirror the write data because the data is written to the disk before posting command completion and mirroring is not required. You can set conditions that cause the controller to change from write-back caching to write-through caching.

In both caching strategies, active-active failover of the controllers is enabled.

You can enable and disable the write-back cache for each volume. By default, volume write-back cache is enabled. Because controller cache is backed by super-capacitor technology, if the system loses power, data is not lost. For most applications, this is the correct setting. But because back-end bandwidth is used to mirror cache and because this mirroring uses back-end bandwidth, if you are writing large chunks of sequential data (as would be done in video editing, telemetry acquisition, or data logging), write-through cache has much better performance. Therefore, you might want to experiment with disabling the write-back cache. You might see large performance gains (as much as 70 percent) if you are writing data under the following circumstances:

- Sequential writes
- Large I/Os in relation to the chunk size
- Deep queue depth

If you are doing random access to this volume, leave the write-back cache enabled.

### Optimizing read-ahead caching

---

- △ **CAUTION:** Only change read-ahead cache settings if you fully understand how the host operating system, application, and adapter move data so that you can adjust the settings accordingly.
- 

You can optimize a volume for sequential reads or streaming data by changing its read-ahead cache settings. Read ahead is triggered by two back-to-back accesses to consecutive LBA ranges, whether forward (increasing LBAs) or reverse (decreasing LBAs).

You can change the amount of data read in advance after two back-to-back reads are made. Increasing the read-ahead cache size can greatly improve performance for multiple sequential read streams; however, increasing read-ahead size will likely decrease random read performance.

- The Default option works well for most applications: it sets one chunk for the first access in a sequential read and one stripe for all subsequent accesses. The size of the chunk is based on the chunk size used when you created the vdisk (the default is 64 KB). Non-RAID and RAID-1 vdisks are considered to have a stripe size of 64 KB.
- Specific size options let you select an amount of data for all accesses.

- The Maximum option lets the controller dynamically calculate the maximum read-ahead cache size for the volume. For example, if a single volume exists, this setting enables the controller to use nearly half the memory for read-ahead cache. Only use Maximum when disk latencies must be absorbed by cache.
- The Disabled option turns off read-ahead cache. This is useful if the host is triggering read ahead for what are random accesses. This can happen if the host breaks up the random I/O into two smaller reads, triggering read ahead.

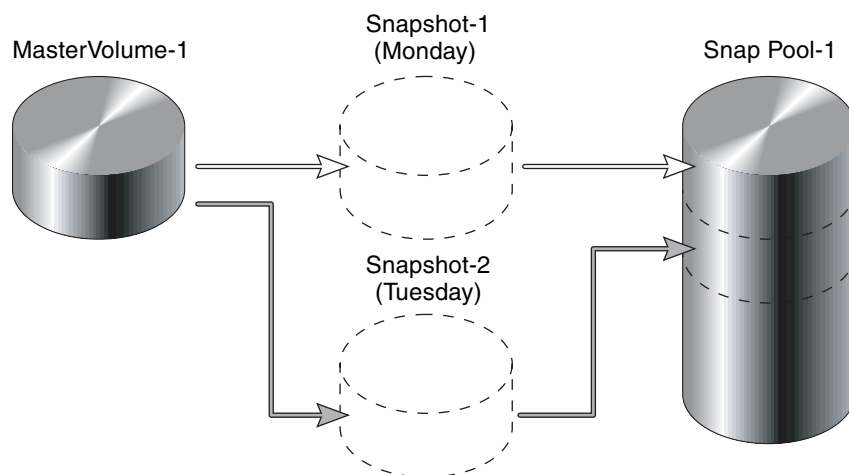
You can also change the optimization mode. The standard read-ahead caching mode works well for typical applications where accesses are a combination of sequential and random; this method is the default. For an application that is strictly sequential and requires extremely low latency, you can use Super Sequential mode. This mode makes more room for read-ahead data by allowing the controller to discard cache contents that have been accessed by the host.

## About the Snapshot feature

Snapshot is a licensed feature that provides data protection by enabling you to create and save snapshots of a volume. Each snapshot preserves the source volume's data state at the point in time when the snapshot was created. Snapshots can be created manually or by using the task scheduler.

When the first snapshot is taken of a standard volume, the system automatically converts the volume into a *master volume* and reserves additional space for snapshot data. This reserved space, called a *snap pool*, stores pointers to the source volume's data. Each master volume has its own snap pool. The system treats a snapshot like any other volume; the snapshot can be mapped to hosts with read-only access, read-write access, or no access, depending on the snapshot's purpose. Any additional unique data written to a snapshot is also stored in the snap pool.

The following figure shows how the data state of a master volume is preserved in the snap pool by two snapshots taken at different points in time. The dotted line used for the snapshot borders indicates that snapshots are logical volumes, not physical volumes as are master volumes and snap pools.



**Figure 1** Relationship between a master volume and its snapshots and snap pool

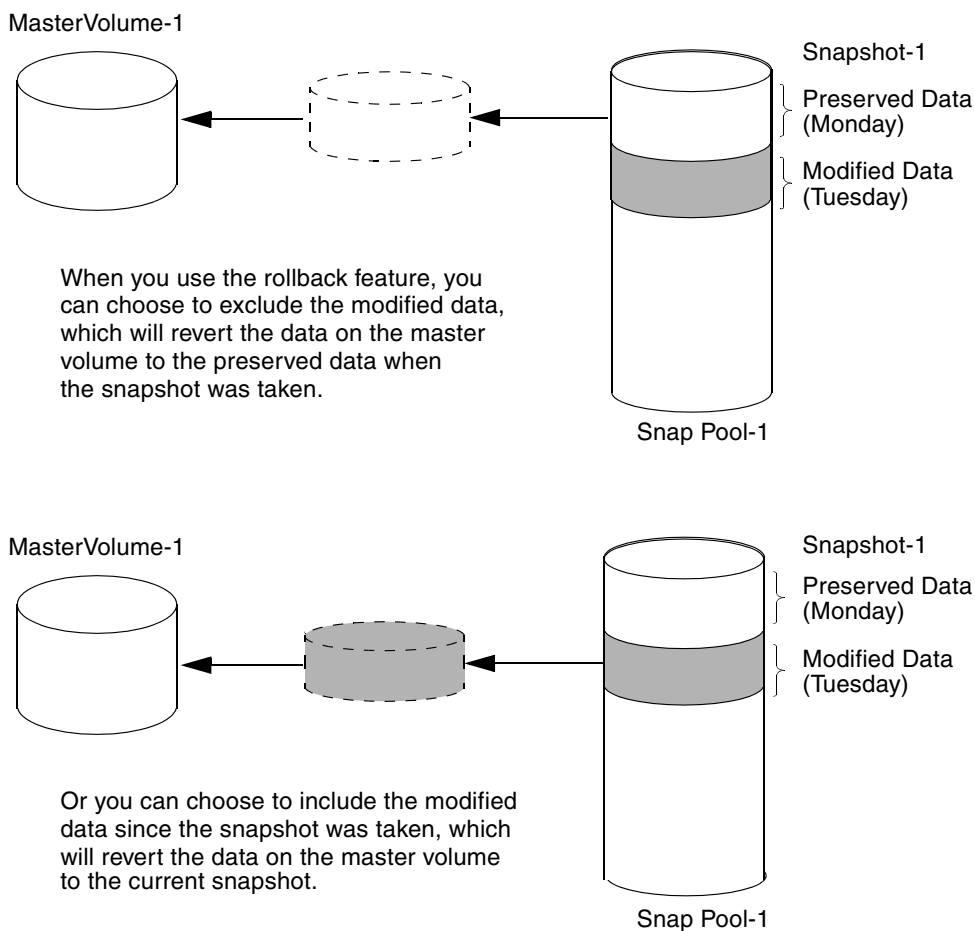
The snapshot feature uses the single copy-on-write method to capture only data that has changed. That is, if a block is to be overwritten on the master volume, and a snapshot depends on the existing data in the block being overwritten, the data is copied from the master volume to the snap pool before the data is changed. All snapshots that depend on the older data are able to access it from the same location in the snap pool; this reduces the impact of snapshots when writing to a master volume. In addition, only a single copy-on-write operation is performed on the master volume.

The storage system allows a maximum number of snapshots to be retained, as determined by an installed license. For example, if your license allows four snapshots, when the fifth snapshot is taken an error message informs you that you have reached the maximum number of snapshots allowed on your system. Before you can create a new snapshot you must either delete an existing snapshot, or purchase and install a license that increases the maximum number of snapshots.

The snapshot service has two features for reverting data back to original data:

- Deleting only modified data on a snapshot. For snapshots that have been made accessible as read-write, you can delete just the modified (write) data that was written directly to a snapshot. When the modified data is deleted, the snapshot data reverts to the original data that was snapped. This feature is useful for testing an application, for example. You might want to test some code, which writes data to the snapshot. Rather than having to take another snapshot, you can just delete any write data and start again.
- Rolling back the data in a source volume. The rollback feature enables you to revert the data in a source volume to the data that existed when a specified snapshot was created (preserved data). Alternatively, the rollback can include data that has been modified (write data) on the snapshot since the snapshot was taken. For example, you might want to take a snapshot, mount that snapshot for read/write, and then install new software on that snapshot for test purposes. If the software installation is successful, you can rollback the master volume to the contents of the modified snapshot (preserved data plus the write data).

The following figure shows the difference between rolling back the master volume to the data that existed when a specified snapshot was created (preserved), and rolling back preserved and modified data.



**Figure 2** Rolling back a master volume

## About the Volume Copy feature

Volume Copy is a licensed feature that enables you to copy a volume or a snapshot to a new standard volume.

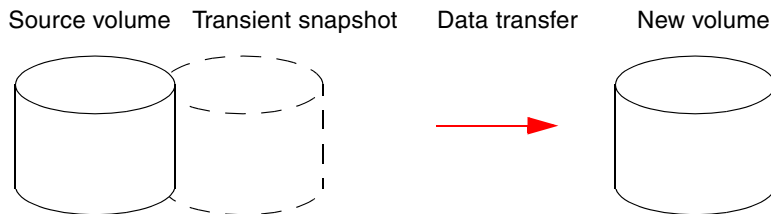
While a snapshot is a point-in-time logical copy of a volume, the volume copy service creates a complete “physical” copy of a volume within a storage system. It is an exact copy of a source volume as it existed at the time the volume copy operation was initiated, consumes the same amount of space as the source volume, and is independent from an I/O perspective. Volume independence is a key distinction of a volume copy (versus a snapshot, which is a “virtual” copy and dependent on the source volume).

Benefits include:

- Additional data protection. An independent copy of a volume (versus logical copy through snapshot) provides additional data protection against a complete master volume failure. If the source master volume fails, the volume copy can be used to restore the volume to the point in time the volume copy was taken.
- Non-disruptive use of production data. With an independent copy of the volume, resource contention and the potential performance impact on production volumes is mitigated. Data blocks between the source and the copied volumes are independent (versus shared with snapshot) so that I/O is to each set of blocks respectively; application I/O transactions are not competing with each other when accessing the same data blocks.

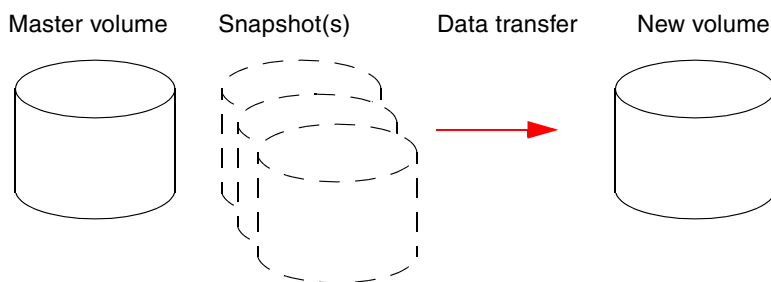
The following figure illustrates how volume copies are created.

#### Creating a volume copy from a standard or master volume



1. Volume copy request is made with a standard volume or a master volume as the source.
2. If the source a standard volume, it is converted to a master volume and a snap pool is created.
3. A new volume is created for the volume copy, and a hidden, transient snapshot is created.
4. Data is transferred from the transient snapshot to the new volume.
5. On completion, the transient volume is deleted and the new volume is a completely independent copy of the master volume, representing the data that was present when the volume copy was started.

#### Creating a volume copy from a snapshot



1. A master volume exists with one or more snapshots associated with it. Snapshots can be in their original state or they can be modified.
2. You can select any snapshot to copy, and you can specify that the modified or unmodified data be copied.
3. On completion, the new volume is a completely independent copy of the snapshot. The snapshot remains, though you can choose to delete it.

**Figure 3** Creating a volume copy from a master volume or a snapshot

Guidelines to keep in mind when performing a volume copy include:

- The destination vdisk must be owned by the same controller as the source volume.
- The destination vdisk must have free space that is at least as large as the amount of space allocated to the original volume. A new volume will be created using this free space for the volume copy.
- The destination vdisk does not need to have the same attributes (such as disk type, RAID level) as the volume being copied.
- Once the copy is complete, the new volume will no longer have any ties to the original.
- Volume Copy makes a copy from a snapshot of the source volume; therefore, the snap pool for the source volume must have sufficient space to store snapshot data when performing this copy.


## About the VDS and VSS hardware providers

Virtual Disk Service (VDS) enables host-based applications to manage vdisks and volumes. Volume Shadow Copy Service (VSS) enables host-based applications to manage snapshots. For more information, see the VDS and VSS hardware provider documentation for your product.

## About RAID levels

The RAID controllers enable you to set up and manage vdisks, whose storage may be spread across multiple disks. This is accomplished through firmware resident in the RAID controller. RAID refers to vdisks in which part of the storage capacity may be used to store redundant data. The redundant data enables the system to reconstruct data if a disk in the vdisk fails.

Hosts see each partition of a vdisk, known as a volume, as a single disk. A volume is actually a portion of the storage space on disks behind a RAID controller. The RAID controller firmware makes each volume appear as one very large disk. Depending on the RAID level used for a vdisk, the disk presented to hosts has advantages in fault-tolerance, cost, performance, or a combination of these.

 **NOTE:** Choosing the right RAID level for your application improves performance.

The following tables:

- Provide examples of appropriate RAID levels for different applications
- Compare the features of different RAID levels
- Describe the expansion capability for different RAID levels

**Table 4** Example applications and RAID levels

Application	RAID level
Testing multiple operating systems or software development (where redundancy is not an issue)	NRAID
Fast temporary storage or scratch disks for graphics, page layout, and image rendering	0
Workgroup servers	1 or 10
Video editing and production	3
Network operating system, databases, high availability applications, workgroup servers	5
Very large databases, web server, video on demand	50
Mission-critical environments that demand high availability and use large sequential workloads	6

**Table 5** RAID level comparison

RAID level	Min. disks	Description	Strengths	Weaknesses
NRAID	1	Non-RAID, nonstriped mapping to a single disk	Ability to use a single disk to store additional data	Not protected, lower performance (not striped)
0	2	Data striping without redundancy	Highest performance	No data protection: if one disk fails all data is lost
1	2	Disk mirroring	Very high performance and data protection; minimal penalty on write performance	High redundancy cost overhead: because all data is duplicated, twice the storage capacity is required
3	3	Block-level data striping with dedicated parity disk	Excellent performance for large, sequential data requests (fast read)	Not well-suited for transaction-oriented network applications: single parity disk does not support multiple, concurrent write requests

**Table 5** RAID level comparison (continued)

RAID level	Min. disks	Description	Strengths	Weaknesses
5	3	Block-level data striping with distributed parity	Best cost/performance for transaction-oriented networks; very high performance and data protection; supports multiple simultaneous reads and writes; can also be optimized for large, sequential requests	Write performance is slower than RAID 0 or RAID 1
6	4	Block-level data striping with double distributed parity	Best suited for large sequential workloads; non-sequential read and sequential read/write performance is comparable to RAID 5	Higher redundancy cost than RAID 5 because the parity overhead is twice that of RAID 5; not well-suited for transaction-oriented network applications; non-sequential write performance is slower than RAID 5
10 (1+0)	4	Stripes data across multiple RAID-1 sub-vdisks	Highest performance and data protection (can tolerate multiple disk failures)	High redundancy cost overhead: because all data is duplicated, twice the storage capacity is required; requires minimum of four disks
50 (5+0)	6	Stripes data across multiple RAID-5 sub-vdisks	Better random read and write performance and data protection than RAID 5; supports more disks than RAID 5	Lower storage capacity than RAID 5

**Table 6** Vdisk expansion by RAID level

RAID level	Expansion capability	Maximum disks
NRAID	Cannot expand.	1
0, 3, 5, 6	You can add 1–4 disks at a time.	16
1	Cannot expand.	2
10	You can add 2 or 4 disks at a time.	16
50	You can add one sub-vdisk at a time. The added sub-vdisk must contain the same number of disks as each of the existing sub-vdisks.	32



## About size representations

In SMU panels, parameters such as names of users and volumes have a maximum length in bytes. ASCII characters are 1 byte; most Latin (Western European) characters with diacritics are 2 bytes; most Asian characters are 3 bytes.

Operating systems usually show volume size in base 2. Disk drives usually show size in base 10. Memory size is always shown in base 2. In SMU, the base for entry and display of storage-space sizes can be set per user or per session. When entering storage-spaces sizes only, either base-2 or base-10 units can be specified.

**Table 7** Size representations in base 2 and base 10

Base 2		Base 10	
Unit	Size in bytes	Unit	Size in bytes
KiB (kibibyte)	$2^{10}$ (1,024)	KB (kilobyte)	$10^3$ (1,000)
MiB (mebibyte)	$2^{20}$ (1,048,576)	MB (megabyte)	$10^6$ (1,000,000)
GiB (gibibyte)	$2^{30}$ (1,073,741,824)	GB (gigabyte)	$10^9$ (1,000,000,000)
TiB (tebibyte)	$2^{40}$ (1,099,511,627,776)	TB (terabyte)	$10^{12}$ (1,000,000,000,000)

The locale setting determines the character used for the decimal (radix) point, as shown below.

**Table 8** Decimal (radix) point character by locale

Language	Character	Examples
English, Chinese, Japanese, Korean	Period (.)	146.81 GB 3.0 Gb/s
Dutch, French, German, Italian, Spanish	Comma (,)	146,81 GB 3,0 Gb/s

## About the system date and time

You can change the storage system's date and time, which are displayed in the System Status panel. It is important to set the date and time so that entries in system logs and event-notification email messages have correct time stamps.

You can set the date and time manually or configure the system to use Network Time Protocol (NTP) to obtain them from a network-attached server. When NTP is enabled, and if an NTP server is available, the system time and date can be obtained from the NTP server. This allows multiple storage devices, hosts, log files, and so forth to be synchronized. If NTP is enabled but no NTP server is present, the date and time are maintained as if NTP was not enabled.

NTP server time is provided in Universal Time (UT), which provides several options:







- If you want to synchronize the times and logs between storage devices installed in multiple time zones, set all the storage devices to use UT.
- If you want to use the local time for a storage device, set its time zone offset.
- If a time server can provide local time rather than UT, configure the storage devices to use that time server, with no further time adjustment.

Whether NTP is enabled or disabled, the storage system does not automatically make time adjustments, such as for U.S. daylight savings time. You must make such adjustments manually.

## About storage-space color codes

SMU panels use the following color codes to identify how storage space is used.

**Table 9** Storage-space color codes

Area	Color	Meaning
Overview panels		Total space
		Available/free space
		Used space
		Reserved space, used for parity and snap pools, for example
Vdisk panels		Space used by spares
		Wasted space, due to use of mixed disk sizes

## About vdisk reconstruction

If one or more disks fail in a redundant vdisk (RAID 1, 3, 5, 6, 10, or 50) and properly sized spares are available, the storage system automatically uses the spares to reconstruct the vdisk. Vdisk reconstruction does not require I/O to be stopped, so the vdisk can continue to be used while the Reconstruct utility runs.

A properly sized spare is one whose capacity is equal to or greater than the smallest disk in the vdisk. If no properly sized spares are available, reconstruction does not start automatically. To start reconstruction manually, replace each failed disk and then do one of the following:

- Add each new disk as either a dedicated spare or a global spare. Remember that a global spare might be taken by a different critical vdisk than the one you intended.
- Enable the Dynamic Spare Capability option to use the new disks without designating them as spares.


Reconstructing a RAID-6 vdisk to a fault-tolerant state requires two properly sized spares to be available.

- If two disks fail and only one properly sized spare is available, an event indicates that reconstruction is about to start. The Reconstruct utility starts to run, using the spare, but its progress remains at 0% until a second properly sized spare is available.
- If a disk fails during online initialization, the initialization fails. In order to generate the two sets of parity that RAID 6 requires, the controller fails a second disk in the vdisk, which changes the vdisk status to Critical, and then assigns that disk as a spare for the vdisk. The Reconstruct utility starts to run, using the spare, but its progress remains at 0% until a second properly sized spare is available.

The second available spare can be an existing global spare, another existing spare for the vdisk, or a replacement disk that you designate as a spare or that is automatically taken when dynamic sparing is enabled.

During reconstruction, you can continue to use the vdisk. When a global spare replaces a disk in a vdisk, the global spare's icon in the enclosure view changes to match the other disks in that vdisk.

---

 **NOTE:** Reconstruction can take hours or days to complete, depending on the vdisk RAID level and size, disk speed, utility priority, and other processes running on the storage system. You can stop reconstruction only by deleting the vdisk.

---

## About data protection in a single-controller storage system

A 2000 G2 Modular Smart Array storage system can be purchased or operated with a single controller. Because single-controller mode is not a redundant configuration, this section presents some considerations concerning data protection.

A volume's default caching mode is write back, as opposed to write through. In write-back mode, data is held in controller cache until it is written to disk. In write-through mode, data is written directly to disk.

If the controller fails while in write-back mode, unwritten cache data likely exists. The same is true if the controller enclosure or the target volume's enclosure is powered off without a proper shut down. Data remains in the controller's cache and associated volumes will be missing that data. This can result in data loss or in some cases volume loss; for example, if using snapshot functionality a snap pool might become inaccessible and the master volume could go offline.

If the controller can be brought back online long enough to perform a proper shut down, the controller should be able to write its cache to disk without causing data loss.

If the controller cannot be brought back online long enough to write its cache data to disk, you can move its CompactFlash cache card to a replacement controller. This enables the cache data to be available when the new controller comes online. The CompactFlash card is externally accessible from the back of the controller.

To avoid the possibility of data loss in case the controller fails you can change a volume's caching mode to write through. While this will cause significant performance degradation, this configuration guards against data loss. While write-back mode is much faster, this mode is not guaranteed against data loss in the case of a controller failure. If data protection is more important, use write-through caching; if performance is more important, use write-back caching.

For details about caching modes see [About volume cache options](#) on page 19. To change a volume's caching mode, see [Changing a volume's cache settings](#) on page 44.



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## 2 Configuring the system

### Using the Configuration Wizard

The Configuration Wizard helps you initially configure the system or change system configuration settings. The wizard has several steps, which are highlighted at the bottom of the panel as you complete them. The last step prompts you to confirm changes before applying them. If you cancel the wizard, no changes are made.

#### Step 1: Starting the wizard

1. In the Configuration View panel, right-click the system and select either **Configuration > Configuration Wizard** or **Wizards > Configuration Wizard**. The wizard panel appears.
2. Click **Next** to continue.

#### Step 2: Change default passwords

The system provides the default users `manage` and `monitor`. To secure the storage system, set a new password for each default user. A password is case sensitive. A password cannot include a comma, double quote, or backslash. Though optional, passwords are highly recommended to ensure system security.

Click **Next** to continue.

#### Step 3: Configuring network ports

You can configure addressing parameters for each controller's network port. You can set static IP values or use DHCP.

In DHCP mode, network port IP address, subnet mask, and gateway values are obtained from a DHCP server if one is available. If a DHCP server is unavailable, current addressing is unchanged. You must have some means of determining what addresses have been assigned, such as the list of bindings on the DHCP server.

---

△ **NOTE:** Changing IP settings can cause management hosts to lose access to the storage system.

---

##### To use DHCP to obtain IP values for network ports

1. Set IP address source to **DHCP**.
2. Click **Next** to continue.

##### To set static IP values for network ports

1. Determine the IP address, subnet mask, and gateway values to use for each controller.
2. Set IP address source to **manual**.
3. Set the values for each controller. You must set a unique IP address for each network port.
4. Click **Next** to continue.

#### Step 4: Enabling system-management services

You can enable or disable management-interface services to limit the ways in which users and host-based management applications can access the storage system. Network management interfaces operate out-of-band and do not affect host I/O to the system. The network options are:

- Web Browser Interface (WBI). The primary interface for managing the system. You can enable use of HTTP, of HTTPS for increased security, or both.
- Command Line Interface (CLI). An advanced user interface for managing the system. You can enable use of Telnet, of SSH (secure shell) for increased security, or both.
- Storage Management Initiative Spec. (SMIS). Used for remote management of the system through your network.

- File Transfer Protocol (FTP). A secondary interface for installing firmware updates, downloading logs, and installing a license.
- Simple Network Management Protocol (SNMP). Used for remote monitoring of the system through your network.
- Service Interface. Used for technical support only.
- Service Debug. Used for technical support only.

In-band management interfaces operate through the data path and can slightly reduce I/O performance. The in-band options are:

- In-band CAPI Capability. Used for in-band management of the system from custom, host-based management applications written using the Configuration Application Programming Interface (CAPI).
- In-band SES Capability. Used for in-band monitoring of system status based on SCSI Enclosure Services (SES) data.

If a service is disabled, it continues to run but cannot be accessed. To allow users to access WBI, CLI, or FTP, see [About user accounts](#) on page 15.

### To change management interface settings

1. Enable the options that you want to use to manage the storage system, and disable the others.
2. Click **Next** to continue.

## Step 5: Setting system information

Enter a name, contact person, location, and description for the system. The system name is shown in the browser title bar or tab. All four values are recorded in system debug logs for reference by service personnel. Click **Next** to continue.

## Step 6: Configuring event notification

Configure up to four email addresses and three SNMP trap hosts to receive notifications of system events.

1. In the Email Configuration section, set the options:
  - Notification Level. Select the minimum severity for which the system should send notifications: Critical (only); Warning (and Critical); Informational (all). The default is none, which disables email notification.
  - SMTP Server address. The IP address of the SMTP mail server to use for the email messages. If the mail server is not on the local network, make sure that the gateway IP address was set in the network configuration step.
  - Sender Name. The sender name that, with the domain name, forms the “from” address for remote notification. Because this name is used as part of an email address, do not include spaces. If no sender name is set, a default name is created.
  - Sender Domain. The domain name that, with the sender name, forms the “from” address for remote notification. Because this name is used as part of an email address, do not include spaces. If no domain name is set here, the default domain value is used. If the domain name is not valid, some email servers will not process the mail.
  - Email Address fields. Up to four email addresses that the system should send notifications to. Email addresses must use the format *user-name@domain-name*.
2. In the SNMP Configuration section, set the options:
  - Notification Level. Select the minimum severity for which the system should send notifications: Critical (only); Warning (and Critical); Informational (all). The default is none, which disables SNMP notification.
  - Read Community. The SNMP read password for your network. The value is case sensitive. The default is `public`.
  - Write Community. The SNMP write password for your network. The value is case sensitive. The default is `private`.
  - Trap Host Address fields. IP addresses of up to three host systems that are configured to receive SNMP traps.

3. Click **Next** to continue.

## Step 7: Configuring host ports

In order for hosts to properly access the system, you must configure the system's host-interface options.


For FC ports you can set these options:

- Speed can be set to auto, which auto-negotiates the proper link speed with the host, or to 2Gb (Gbit per second) or 4Gb. A speed mismatch with a host prevents that host from accessing the storage system.
- Connection mode can be set to loop or point-to-point. Loop protocol can be used in a physical loop or in a direct physical connection between two devices. Point-to-point protocol can only be used on a direct physical connection between exactly two devices.
- Loop IDs can be set, per controller, to use soft or hard target addressing:
  - Soft target addressing (the default) enables a LIP to determine the loop ID. Use this setting if the loop ID is permitted to change after a LIP or power cycle.
  - Hard target addressing requests a specific loop ID that should remain after a LIP or power cycle. If the port cannot acquire the specified ID, it is assigned a soft target address. Use this option if you want ports to have specific addresses, if your system checks addresses in reverse order (lowest address first), or if an application requires that specific IDs be assigned to recognize the controller.

For iSCSI ports you can set these options:

- IP Address. The port IP address in IPv4 format.
- Netmask. The port netmask address in IPv4 format.
- Gateway. The port gateway address in IPv4 format.
- Authentication (CHAP). Enables or disables use of Challenge Handshake Authentication Protocol. Disabled by default.
- Jumbo Frames. Enables or disables support for jumbo frames. A normal frame can contain 1500 bytes whereas a jumbo frame can contain a maximum of 9000 bytes for larger data transfers. Disabled by default.

---

 **NOTE:** Use of jumbo frames can succeed only if jumbo-frame support is enabled on all network components in the data path.

---

- Link Speed. Sets the link speed to auto, which allows the system to negotiate the proper speed, or forces it to 1 Gbit/sec (1g). The default is auto.
- iSNS. Enables or disables registration with a specified Internet Storage Name Service server, which provides name-to-IP-address mapping. Disabled by default.
- iSNS Address. Specifies the IP address of an iSNS server. The default address is all zeroes.
- Alternate iSNS Address. Specifies the IP address of an alternate iSNS server, which can be on a different subnet. The default address is all zeroes.

For SAS ports there are no host-interface options. Click **Next** to continue.

### To change FC host-interface settings

1. For controller host ports that are attached to hosts:
  - Set the speed to the proper value to communicate with the host.
  - Set the connection mode to loop or point-to-point.
2. For each controller, set the loop ID to use soft or hard target addressing. To use soft target addressing, select **Soft?**. To use hard target addressing, clear **Soft?** and enter an address in the range 0–125. You cannot set the same hard target address for both controllers. An asterisk indicates that the value shown will be changed.
3. Click **Next** to continue.

### To change iSCSI host-interface settings


1. For each iSCSI port, set the IP address, netmask, and gateway.
2. For all iSCSI ports, set the authentication, jumbo frames, link speed, and iSNS options.
3. Click **Next** to continue.

## Step 8: Confirming configuration changes

Confirm that the values listed in the wizard panel are correct.

- If they are not correct, click **Previous** to return to previous steps and make necessary changes.
- If they are correct, click **Finish** to apply the setting changes and finish the wizard.

---

 **NOTE:** If you changed a controller's FC loop ID setting, you must restart the controller to make the change take effect.

---

## Installing a license

A license is required to expand Snapshot limits and to use Volume Copy. The license is specific to a controller enclosure serial number and firmware version.

If a permanent license is not installed and you want to try the Snapshot and Volume Copy features before buying a permanent license, you can create a temporary license one time. A temporary license will expire 60 days from the time it is created. After creating a temporary license, each time you sign in to SMU, a message specifies the time remaining in the trial period. If you do not install a permanent license before the temporary license expires, you cannot create new snapshots or volume copies; however, you can continue to use existing snapshots and volume copies.

After a temporary license is created or a permanent license is installed, the option to create a temporary license is no longer displayed.

### To view information about system licenses

In the Configuration View panel, right-click the system and select **Tools > Install License**.

The System Licenses table shows the following information about licensed features:

- License Key. The license key number or "not installed" if no license is installed.
- Licensed Snapshots. The number of snapshots that the installed license provides.
- Maximum Licensable Snapshots. The number of snapshots that the product supports.
- Volume Copy. Shows whether volume copy functions are enabled or disabled.
- VDS. Shows that the VDS (Virtual Disk Service) Hardware Provider is enabled.
- VSS. Shows that the VSS (Virtual Shadow Copy Service) Hardware Provider is enabled.
- License Duration. Shows the number of days remaining in the trial period if a temporary license is installed.

The panel also shows the licensing serial number (controller enclosure serial number) and licensing version number (controller firmware version), for which a license file must be generated in order to successfully install.

### To create a temporary license

1. In the Configuration View panel, right-click the system and select **Tools > Install License**. If the option to create a temporary license is available, the End User License Agreement appears in the lower portion of the license panel.
2. Read the license agreement.
3. If you accept the terms of the license agreement, select the checkbox. A confirmation dialog appears.
4. Click **Yes** to start the trial period. The time remaining in the trial period is shown in the panel's License Duration field.



## To install a permanent license

1. Ensure that:
  - The license file is saved to a network location that SMU can access.
  - You are signed into the controller enclosure that the file was generated for.
2. In the Configuration View panel, right-click the system and select **Tools > Install License**.
3. Click **Browse** to locate and select the license file.
4. Click **Install License File**. If installation succeeds, the System Licenses table is updated. The licensing changes take effect immediately.

## Configuring system services

### Changing management interface settings

You can enable or disable management interfaces to limit the ways in which users and host-based management applications can access the storage system. Network management interfaces operate out-of-band and do not affect host I/O to the system. The network options are:

- Web Browser Interface (WBI). The primary interface for managing the system. You can enable use of HTTP, of HTTPS for increased security, or both.
- Command Line Interface (CLI). An advanced user interface for managing the system. You can enable use of Telnet, of SSH (secure shell) for increased security, or both.
- Storage Management Initiative Specification (SMIS). Used for remote management of the system through your network.
- File Transfer Protocol (FTP). A secondary interface for installing firmware updates, downloading logs, and installing a license.
- Simple Network Management Protocol (SNMP). Used for remote monitoring of the system through your network.
- Service Interface. Used for technical support only.
- Service Debug. Used for technical support only.

In-band management interfaces operate through the data path and can slightly reduce I/O performance. The in-band options are:

- In-band CAPI Capability. Used for in-band management of the system from custom, host-based management applications written using the Configuration Application Programming Interface (CAPI).
- In-band SES Capability. Used for in-band monitoring of system status based on SCSI Enclosure Services (SES) data.

If a service is disabled, it continues to run but cannot be accessed. To allow users to access WBI, CLI, or FTP, see [About user accounts](#) on page 15.

### To change management interface settings

1. In the Configuration View panel, right-click the system and select **Configuration > Services > Management**.
2. In the Network Management Services section, enable the options that you want to use to manage the storage system, and disable the others.
3. Click **Apply**. If you disabled any options, a confirmation dialog appears.
4. Click **Yes** to continue; otherwise, click **No**. If you clicked No, a processing dialog appears. When processing is complete a success dialog appears.
5. Click **OK**.

## Configuring email notification

### To configure email notification of events

1. In the Configuration View panel, right-click the system and select **Configuration > Services > Email Notification**.
2. In the main panel, set the options:
  - Notification Level. Select the minimum severity for which the system should send notifications: Critical (only); Warning (and Critical); Informational (all). The default is none, which disables email notification.
  - SMTP Server address. The IP address of the SMTP mail server to use for the email messages. If the mail server is not on the local network, make sure that the gateway IP address is set in System Settings > Network Interfaces.
  - Sender Name. The sender name that, with the domain name, forms the “from” address for remote notification. Because this name is used as part of an email address, do not include spaces. If no sender name is set, a default name is created.
  - Sender Domain. The domain name that, with the sender name, forms the “from” address for remote notification. Because this name is used as part of an email address, do not include spaces. If no domain name is set here, the default domain value is used. If the domain name is not valid, some email servers will not process the mail.
  - Email Address fields. Up to four email addresses that the system should send notifications to. Email addresses must use the format *user-name@domain-name*.
3. Click **Apply**.

## Configuring SNMP notification

### To configure SNMP notification of events

1. In the Configuration View panel, right-click the system and select **Configuration > Services > SNMP Notification**.
2. In the main panel, set the options:
  - Notification Level. Select the minimum severity for which the system should send notifications: Critical (only); Warning (and Critical); Informational (all). The default is none, which disables SNMP notification.
  - Read Community. The SNMP read password for your network. The value is case sensitive. The default is public.
  - Write Community. The SNMP write password for your network. The value is case sensitive. The default is private.
  - Trap Host Address fields. IP addresses of up to three host systems that are configured to receive SNMP traps.
3. Click **Apply**

## Configuring user accounts


### Adding users

#### To add a user

1. In the Configuration View panel, right-click the system and select **Configuration > Users > Add User**.
2. In the main panel, set the options:
  - User Name. A user name is case sensitive and cannot already exist in the system. A name cannot include a comma, double quote, or backslash.
  - Password. A password is case sensitive. A password cannot include a comma, double quote, or backslash. Though optional, passwords are highly recommended to ensure system security.
  - Access Level. Select Monitor to let the user view system settings, or Manage to let the user view and change system settings.

- **User Type.** Select Standard to allow access to standard functions, or Advanced to allow access to all functions except diagnostic functions, or Diagnostic to allow access to all functions.

---

 **NOTE:** This release has no functions that require Advanced or Diagnostic access; a Standard user can access all functions.

---

- **WBI Access.** Allows access to the web-based management interface.
- **CLI Access.** Allows access to the command-line management interface.
- **FTP Access.** Allows access to the file transfer protocol interface, which provides a way to install firmware updates and download logs.
- **Base Preference.** Select Base 2 to show sizes as powers of 2 (binary) using 1024 as a divisor, or Base 10 to show sizes as powers of 10 (decimal) using 1000 as a divisor.
- **Precision Preference.** Number of decimal places to use for sizes.
- **Unit Preference.** Select Auto to let the system determine the proper units for sizes, or select the units to use for all sizes.
- **Temperature Preference.** Specifies to use either the Celsius scale or the Fahrenheit scale for temperature values.
- **Auto Sign Out.** Select the amount of time that the user's session can be idle before the user is automatically signed out: 5, 15, or 30 minutes, or Never (9999 minutes). The default is 30 minutes.
- **Locale.** The user's preferred display language, which overrides the system's default display language. Installed language sets include Chinese-simplified, Chinese-traditional, Dutch, English, French, German, Italian, Japanese, Korean, and Spanish.


### 3. Click **Add User**.

## Modifying users

### To modify a user

1. In the Configuration View panel, right-click the system and select **Configuration > Users > Modify User**.
2. In the main panel, select the user to modify.
3. Set the options:
  - **User Name.** A user name is case sensitive and cannot already exist in the system. A name cannot include a comma, double quote, or backslash.
  - **Password.** A password is case sensitive. A password cannot include a comma, double quote, or backslash. Though optional, passwords are highly recommended to ensure system security.
  - **Access Level.** Select Monitor to let the user view system settings, or Manage to let the user view and change system settings. You cannot change the access level of user manage.
  - **User Type.** Select Standard to allow access to standard functions, or Advanced to allow access to all functions except diagnostic functions, or Diagnostic to allow access to all functions.

---

 **NOTE:** This release has no functions that require Advanced or Diagnostic access; a Standard user can access all functions.

---

- **WBI Access.** Allows access to the web-based management interface.
- **CLI Access.** Allows access to the command-line management interface.
- **FTP Access.** Allows access to the file transfer protocol interface, which provides a way to install firmware updates and download logs.
- **Base Preference.** Select Base 2 to show sizes as powers of 2 (binary) using 1024 as a divisor, or Base 10 to show sizes as powers of 10 (decimal) using 1000 as a divisor.
- **Precision Preference.** Number of decimal places to use for sizes.
- **Unit Preference.** Select Auto to let the system determine the proper units for sizes, or select the units to use for all sizes.

- Temperature Preference. Specifies to use either the Celsius scale or the Fahrenheit scale for temperature values.
- Auto Sign Out. Select the amount of time that the user's session can be idle before the user is automatically signed out: 5, 15, or 30 minutes, or Never (9999 minutes). The default is 30 minutes.
- Locale. The user's preferred display language, which overrides the system's default display language. Installed language sets include Chinese-simplified, Chinese-traditional, Dutch, English, French, German, Italian, Japanese, Korean, and Spanish.

4. Click **Modify User**.

## Removing users

### To remove a user

1. In the Configuration View panel, right-click the system and select **Configuration > Users > Remove User**.
2. In the main panel, select the user to remove. You cannot remove the manage user.
3. Click **Remove User**. A confirmation dialog appears.
4. Click **Remove** to continue; otherwise, click **Cancel**. If you clicked Remove, a processing dialog appears. When processing is complete, the user is removed from the table.
5. Click **OK**.

## Configuring system settings

### Changing the system date and time

You can enter values manually for the system date and time, or you can set the system to use NTP as explained in [About the system date and time](#) on page 25.

#### To use manual date and time settings

1. In the Configuration View panel, right-click the system and select **Configuration > System Settings > Date, Time**. The date and time options appear.
2. Set the options:
  - Time. Enter the time in the format hh:mm:ss.
  - Month.
  - Day.
  - Year. Enter the year using four digits.
  - Network Time Protocol (NTP). Select **Disabled**.
3. Click **Apply**.

#### To obtain the date and time from an NTP server

1. In the Configuration View panel, right-click the system and select **Configuration > System Settings > Date, Time**. The date and time options appear.
2. Set the options:
  - Network Time Protocol (NTP). Select **Enabled**.
  - NTP Time Zone Offset. Optional. If the system timestamps should use the NTP server's time zone instead of the local time zone, enter the time zone offset.
  - NTP Server Address. Optional. If the system should retrieve time values from a specific NTP server, enter the address of an NTP server. If no IP server address is set, the system listens for time messages sent by an NTP server in broadcast mode.
3. Click **Apply**.

## Changing host interface settings

In order for hosts to properly access the system, you must configure the system's host-interface options. There are options for FC and iSCSI ports but not for SAS ports.

### To change FC host interface settings

1. In the Configuration View panel, right-click the system and select **Configuration > System Settings > Host Interfaces**.
2. Set the speed to the proper value to communicate with the host. Speed can be set to auto, which auto-negotiates the proper link speed with the host, or to 2Gb (Gbit per second) or 4Gb. A speed mismatch with a host prevents that host from accessing the storage system.
3. Set the connection mode to loop or point-to-point. Loop protocol can be used in a physical loop or in a direct physical connection between two devices. Point-to-point protocol can only be used on a direct physical connection between exactly two devices.
4. Set the loop ID for each controller to request when the controller arbitrates during a LIP. A controller can use soft or hard target addressing:
  - Soft target addressing (the default) enables a LIP to determine the loop ID. Use this setting if the loop ID is permitted to change after a LIP or power cycle. To use this option, select **Soft?**.
  - Hard target addressing requests a specific loop ID that should remain after a LIP or power cycle. If the port cannot acquire the specified ID, it is assigned a soft target address. Use this option if you want ports to have specific addresses, if your system checks addresses in reverse order (lowest address first), or if an application requires that specific IDs be assigned to recognize the controller. To use this option, clear **Soft** and enter an address in the range 0–125. You cannot set the same hard target address for both controllers.
5. Click **Apply**. If you changed a loop ID setting, a message specifies that you must restart the controller to make the change take effect. An asterisk indicates that the value shown will be changed.

### To change iSCSI host interface settings

1. In the Configuration View panel, right-click the system and select **Configuration > System Settings > Host Interfaces**.
2. Set the port-specific options:
  - IP Address. For each controller, assign one port to one subnet and the other port to a second subnet. For example:
    - Controller A port 0: 10.10.10.100
    - Controller A port 1: 10.11.10.120
    - Controller B port 0: 10.10.10.110
    - Controller B port 1: 10.11.10.130
  - Netmask. IP subnet mask. The default is 255.255.255.0.
  - Gateway. Gateway IP address. The default is 0.0.0.0.


---

△ **CAUTION:** Changing IP settings can cause data hosts to lose access to the storage system.

---

3. Set the common options:
  - Authentication (CHAP). Enables or disables use of Challenge Handshake Authentication Protocol. Disabled by default.
  - Jumbo Frames. Enables or disables support for jumbo frames. A normal frame can contain 1500 bytes whereas a jumbo frame can contain a maximum of 9000 bytes for larger data transfers. Disabled by default.

---

 **NOTE:** Use of jumbo frames can succeed only if jumbo-frame support is enabled on all network components in the data path.

---

- Link Speed. Sets the link speed to auto, which allows the system to negotiate the proper speed, or forces it to 1 Gbit/sec (1g). The default is auto.
- iSNS. Enables or disables registration with a specified Internet Storage Name Service server, which provides name-to-IP-address mapping. Disabled by default.
- iSNS Address. Specifies the IP address of an iSNS server. The default address is all zeroes.
- Alternate iSNS Address. Specifies the IP address of an alternate iSNS server, which can be on a different subnet. The default address is all zeroes.

4. Click **Apply**.

## Changing network interface settings

You can configure addressing parameters for each controller's network port. You can set static IP values or use DHCP.

In DHCP mode, network port IP address, subnet mask, and gateway values are obtained from a DHCP server if one is available. If a DHCP server is unavailable, current addressing is unchanged. You must have some means of determining what addresses have been assigned, such as the list of bindings on the DHCP server.

---

△ **NOTE:** Changing IP settings can cause management hosts to lose access to the storage system.

---

### To use DHCP to obtain IP values for network ports

1. In the Configuration View panel, right-click the system and select **Configuration > System Settings > Network Interfaces**.
2. Set **IP address source** to **DHCP**.
3. Click **Apply**. If the controllers successfully obtain IP values from the DHCP server, the new IP values are displayed.
4. Record the new addresses.
5. Sign out and try to access SMU using the new IP addresses.

### To set static IP values for network ports

1. Determine the IP address, subnet mask, and gateway values to use for each controller.
2. In the Configuration View panel, right-click the system and select **Configuration > System Settings > Network Interfaces**.
3. Set **IP address source** to manual.
4. Set the options for each controller. You must set a unique IP address for each network port.
5. Record the IP values you assign.
6. Click **Apply**.
7. Sign out and try to access SMU using the new IP addresses.

## Setting system information

### To set system information

1. In the Configuration View panel, right-click the system and select **Configuration > System Settings > System Information**.
2. In the main panel, set the name, contact person or group, location, and other information about the system. The system name is shown in the browser title bar or tab. All four values are recorded in system debug logs for reference by service personnel.
3. Click **Apply**.

## Configuring advanced settings

### Changing disk settings

#### Configuring SMART

Self-Monitoring Analysis and Reporting Technology (SMART) provides data that enables you to monitor disks and analyze why a disk failed. When SMART is enabled, the system checks for SMART events one minute after a restart and every five minutes thereafter. SMART events are recorded in the event log.

##### To change the SMART setting

1. In the Configuration View panel, right-click the system and select **Configuration > Advanced Settings > Disk**.
2. Set **SMART Configuration** to either:
  - **Don't Modify**. Allows current disks to retain their individual SMART settings and does not change the setting for new disks added to the system.
  - **Enabled**. Enables SMART for all current disks after the next rescan and automatically enables SMART for new disks added to the system. This option is the default.
  - **Disabled**. Disables SMART for all current disks after the next rescan and automatically disables SMART for new disks added to the system.
3. Click **Apply**.

#### Configuring dynamic spares

The dynamic spares feature lets you use all of your disks in redundant vdisks without designating a disk as a spare. With dynamic spares enabled, if a disk fails and you replace it with a properly sized disk, the storage system rescans the bus, finds the new disk, automatically designates it a spare, and starts reconstructing the vdisk. A properly sized disk is one whose capacity is equal to or greater than the smallest disk in the vdisk. If a dedicated spare, global spare, or properly sized available disk is already present, the dynamic spares feature uses that disk to start the reconstruction and the replacement disk can be used for another purpose.

##### To change the dynamic spares setting

1. In the Configuration View panel, right-click the system and select **Configuration > Advanced Settings > Disk**.
2. Either select (enable) or clear (disable) the **Dynamic Spare Capability** option.
3. Click **Apply**.

#### Configuring the EMP polling rate

You can change the interval at which the storage system polls each attached enclosure's EMP for status changes. Typically you can use the default setting.

- Increasing the interval might slightly improve processing efficiency, but changes in device status are communicated less frequently. For example, this increases the amount of time before LEDs are updated to reflect status changes.
- Decreasing the interval slightly decreases processing efficiency, but changes in device status are communicated more frequently. For example, this decreases the amount of time before LEDs are updated to reflect status changes.

##### To change the EMP polling rate

1. In the Configuration View panel, right-click the system and select **Configuration > Advanced Settings > Disk**.
2. Set the EMP Polling Rate interval. The default is 5 seconds.
3. Click **Apply**.

## Changing cache settings

### Changing the synchronize-cache mode

You can control how the storage system handles the `SCSI SYNCHRONIZE CACHE` command. Typically you can use the default setting. However, if the system has performance problems or problems writing to databases or other applications, contact technical support to determine if you should change this option.

#### To change the synchronize-cache mode

1. In the Configuration View panel, right-click the system and select **Configuration > Advanced Settings > Cache**.
2. Set **Sync Cache Mode** to either:
  - **Immediate**. Good status is returned immediately and cache content is unchanged. This is the default.
  - **Flush to Disk**. Good status is returned only after all write-back data for the specified volume is flushed to disk.
3. Click **Apply**.

### Changing the missing LUN response

Some operating systems do not look beyond LUN 0 if they do not find a LUN 0 or cannot handle noncontiguous LUNs. The Missing LUN Response option handles these situations by enabling the host drivers to continue probing for LUNs until they reach the LUN to which they have access.

This option controls the SCSI sense data returned for volumes that are not accessible because they don't exist or have been hidden through volume mapping (this does not apply to volumes of offline vdisks). Use the default value unless a service technician asks you to change it to work around a host driver problem.

#### To change the missing LUN response

1. In the Configuration View panel, right-click the system and select **Configuration > Advanced Settings > Cache**.
2. Set **Missing LUN Response** to either:
  - **Not Ready**. Sends a reply that there is a LUN where a gap has been created but that it's "not ready." Sense data returned is a Sense Key of 2h and an ASC/ASCQ of 04/03. This option is the default.
  - **Illegal Request**. Sends a reply that there is a LUN but that the request is "illegal." Sense data returned is a Sense Key of 5h and an ASC/ASCQ of 25/00.
3. Click **Apply**.

### Controlling host access to the system's write-back cache setting

You can prevent hosts from using `SCSI MODE SELECT` commands to change the system's write-back cache setting. Some operating systems disable write cache. If host control of write-back cache is disabled, the host cannot modify the cache setting. The default is Disabled.

This option is useful in some environments where the host disables the system's write-back cache, resulting in degraded performance.

#### To change host access to the write-back cache setting

1. In the Configuration View panel, right-click the system and select **Configuration > Advanced Settings > Cache**.
2. Either select (enable) or clear (disable) the **Host Control of Write-Back Cache** option.
3. Click **Apply**.



## Changing auto-write-through cache triggers and behaviors

You can set conditions that cause (“trigger”) a controller to change the cache mode from write-back to write-through, as described in [About volume cache options](#) on page 19. You can also specify actions for the system to take when write-through caching is triggered.

### To change auto-write-through cache triggers and behaviors

1. In the Configuration View panel, right-click the system and select **Configuration > Advanced Settings > Cache**.
2. In the Auto-Write Through Cache Trigger Conditions section, either select (enable) or clear (disable) the options:
  - **Controller Failure**. Changes to write-through if a controller fails. Disabled by default.
  - **Cache Power**. Changes to write-through if cache backup power is not fully charged or fails. Enabled by default.
  - **CompactFlash**. Changes to write-through if CompactFlash memory is not detected during POST, fails during POST, or fails while the controller is under operation. Enabled by default.
  - **Power Supply Failure**. Changes to write-through if a power supply unit fails. Disabled by default.
  - **Fan Failure**. Changes to write-through if a cooling fan fails. Disabled by default.
  - **Overtemperature Failure**. Forces a controller shutdown if a temperature is detected that exceeds system threshold limits. Disabled by default.
3. In the Auto-Write Through Cache Behaviors section, either select (enable) or clear (disable) the options:
  - **Revert when Trigger Condition Clears**. Changes back to write-back caching after the trigger condition is cleared. Enabled by default.
  - **Notify Other Controller**. Notifies the partner controller that a trigger condition occurred. Enable this option to have the partner also change to write-through mode for better data protection. Disable this option to allow the partner continue using its current caching mode for better performance. Disabled by default.
4. Click **Apply**.

## Configuring partner firmware update

In a dual-controller system, when you update firmware on one controller, the system also updates the partner controller. Disable partner firmware update only if requested by a service technician.

### To change the partner firmware update setting

1. In the Configuration View panel, right-click the system and select **Configuration > Advanced Settings > Firmware**.
2. Either select (enable) or clear (disable) the **Partner Firmware Update** option.
3. Click **Apply**.


## Configuring system utilities

### Configuring background scrub

You can enable or disable whether the system continuously analyzes disks in vdisks to detect, report, and store information about disk defects. Vdisk-level errors reported include: hard errors, medium errors, and bad block replacements (BBRs). Disk-level errors reported include: metadata read errors, SMART events during scrub, bad blocks during scrub, and new disk defects during scrub. For RAID 3, 5, 6, and 50, the utility checks all parity blocks to find data-parity mismatches. For RAID 1 and 10, the utility compares the primary and secondary disks to find data inconsistencies. For NRAID and RAID 0, the utility checks for media errors.

You can use a vdisk while it is being scrubbed. Background scrub always runs at background utility priority, which reduces to no activity if CPU usage is above a certain percentage or if I/O is occurring on the vdisk being scrubbed. A background scrub may be in process on multiple vdisks at once. A new vdisk will first be scrubbed 20 minutes after creation. After a vdisk is scrubbed, scrub will start again in 24 hours. When a scrub is complete, the number of errors found is reported with event code 207 in the event log.

---

 **TIP:** If you choose to disable background scrub, you can still scrub selected vdisks by using Media Scrub Vdisk.

---

### To change the background scrub setting

1. In the Configuration View panel, right-click the system and select **Configuration > Advanced Settings > System Utilities**.
2. Either select (enable) or clear (disable) the **Background Scrub** option.
3. Click **Apply**.

## Configuring utility priority

You can change the priority at which the Verify, Reconstruct, Expand, and Initialize utilities run when there are active I/O operations competing for the system's controllers.

### To change the utility priority

1. In the Configuration View panel, right-click the system and select **Configuration > Advanced Settings > System Utilities**.
2. Set **Utility Priority** to either:
  - **High.** Use when your highest priority is to get the system back to a fully fault-tolerant state. This causes heavy I/O with the host to be slower than normal. This value is the default.
  - **Medium.** Use when you want to balance data streaming with data redundancy.
  - **Low.** Use when streaming data without interruption, such as for a web server, is more important than data redundancy. This enables a utility such as Reconstruct to run at a slower rate with minimal effect on host I/O.
  - **Background.** Utilities run only when the processor has idle cycles.
3. Click **Apply**.

## Configuring a vdisk

### Managing dedicated spares

You can assign a maximum of four available disks to a redundant vdisk (RAID 1, 3, 5, 6, 10, 50) for use as spares by that vdisk only. A spare must be the same type (SAS or SATA, small or large form-factor) as other disks in the vdisk, and have sufficient capacity to replace the smallest disk in the vdisk.

If a disk in the vdisk fails, a dedicated spare is automatically used to reconstruct the vdisk. A redundant vdisk other than RAID-6 becomes Critical when one disk fails. A RAID-6 vdisk becomes Degraded when one disk fails and Critical when two disks fail. After the vdisk's parity or mirror data is completely written to the spare, the vdisk returns to fault-tolerant status. For RAID-50 vdisks, if more than one sub-vdisk becomes critical, reconstruction and use of assigned spares occur in the order sub-vdisks are numbered.

### To change a vdisk's spares

1. In the Configuration View panel, right-click a vdisk and select **Configuration > Manage Dedicated Spares**. The main panel shows information about the selected vdisk, its spares, and all disks in the system. Existing spares are labeled SPARE.
  - In the Disk Selection Sets table, the number of empty slots in the SPARE entry's Disks field shows how many spares you can add to the vdisk.
  - In the enclosure view or list, only existing spares and suitable available disks are selectable.
2. Select spares to remove, disks to add as spares, or both.
3. Click **Modify Spares**. If the task succeeds, the panel is updated to show which disks are now spares for the vdisk.

## Changing a vdisk's name

### To change a vdisk's name

1. In the Configuration View panel, right-click a vdisk and select **Configuration > Modify Vdisk Name**. The main panel shows the vdisk's name.
2. Enter a new name. A vdisk name is case sensitive and cannot already exist in the system. A name cannot include a comma, double quote, or backslash.
3. Click **Modify Name**. The new name appears in the Configuration View panel.

## Changing a vdisk's owner

Each vdisk is owned by one of the controllers, known as the *preferred owner*. Typically, you should not need to change vdisk ownership.

When a controller fails, the partner controller assumes temporary ownership of the failed controller's vdisks and resources, becoming the *current owner*. If the system uses a fault-tolerant cabling configuration, both controllers' LUNs will be accessible through the partner.

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△ **CAUTION:** Before changing the owning controller for a vdisk, you must stop host I/O to the vdisk's volumes. Volume mappings are not affected.

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### To change a vdisk's owner

1. In the Configuration View panel, right-click a vdisk and select **Configuration > Modify Vdisk Owner**. The main panel shows the vdisk's owner.
2. Select a new owner.
3. Click **Modify Owner**. A confirmation dialog appears.
4. Click **Yes** to continue; otherwise, click **Cancel**. If you clicked Yes, a processing dialog appears. When processing is complete a success dialog appears.
5. Click **OK**.

## Configuring a volume

### Changing a volume's name or OpenVMS UID

#### To change a volume's name

1. In the Configuration View panel, right-click a volume and select **Configuration > Modify Volume Name**.
2. Enter a new name. A volume name is case sensitive and cannot already exist in a vdisk. A name cannot include a comma, double quote, or backslash.
3. Click **Modify Name**. The new name appears in the Configuration View panel.

#### To change a volume's OpenVMS UID

1. In the Configuration View panel, right-click a volume and select **Configuration > Modify Volume Name**.
2. Enter a number in the range 1–32767 to identify the volume to the OpenVMS host.
3. Click **Modify UID**.

## Changing a volume's cache settings

---

### △ CAUTION:

- Only disable write-back caching if you fully understand how the host operating system, application, and adapter move data. If used incorrectly, you might hinder system performance.
  - Only change read-ahead cache settings if you fully understand how the host operating system, application, and adapter move data so that you can adjust the settings accordingly.
- 

### To change a volume's cache settings

1. In the Configuration View panel, right-click a volume and select **Configuration > Modify Volume Cache Settings**.
2. In the main panel, set the read-ahead cache options:
  - Write Policy. Select write-back or write-through. The default is write-back.
  - Write Optimization. Select Standard or Super Sequential. The default is Standard.
  - Read Ahead Size. Select Default, a specific size (64, 128, 256, or 512 KB; 1, 2, 4, 8, 16, or 32 MB), Maximum, or Disabled.
3. Click **Modify Cache Settings**.

## 3 Provisioning the system

### Using the Provisioning Wizard

The Provisioning Wizard helps you create a vdisk with volumes and to map the volumes to hosts. The wizard has several steps, which are highlighted at the bottom of the panel as you complete them. The last step prompts you to confirm changes before applying them. If you cancel the wizard, no changes are made.

#### Step 1: Starting the wizard

1. In the Configuration View panel, right-click the system and select either **Provisioning > Provisioning Wizard** or **Wizards > Provisioning Wizard**. The wizard panel appears.
2. Click **Next** to continue.

#### Step 2: Specifying the vdisk name and RAID level

A *vdisk* is a “virtual” disk that is composed of one or more disks, and has the combined capacity of those disks. The number of disks that a vdisk can contain is determined by its RAID level. All disks in a vdisk must be the same type (SAS or SATA, small or large form-factor). A maximum of 16 vdisks per controller can exist.

A vdisk can contain different models of disks, and disks with different capacities. For example, a vdisk can include a 500-GB disk and a 750-GB disk. If you mix disks with different capacities, the smallest disk determines the logical capacity of all other disks in the vdisk, regardless of RAID level. For example, if a RAID-0 vdisk contains one 500-GB disk and four 750-GB disks, the capacity of the vdisk is equivalent to approximately five 500-GB disks. To maximize capacity, use disks of similar size. For greatest reliability, use disks of the same size and rotational speed.

In a single-controller system, all vdisks are owned by that controller. In a dual-controller system, when a vdisk is created the system automatically assigns the owner to balance the number of vdisks each controller owns; or, you can select the owner. Typically it doesn't matter which controller owns a vdisk.

In a dual-controller system, when a controller fails, the partner controller assumes temporary ownership of the failed controller's vdisks and resources. If the system uses a fault-tolerant cabling configuration, both controllers' LUNs become accessible through the partner.

When you create a vdisk you can also create volumes within it. A volume is a logical subdivision of a vdisk, and can be mapped to controller host ports for access by hosts. The storage system presents only volumes, not vdisks, to hosts.

#### To create a vdisk

1. Set the options:
  - Vdisk name. Optionally change the default name for the vdisk. A vdisk name is case sensitive and cannot already exist in the system. A name cannot include a comma, double quote, or backslash.
  - Assign to. Optionally select a controller to be the preferred owner for the vdisk. The default, Auto, automatically assigns the owner to load-balance vdisks between controllers.
  - RAID Level. Select a RAID level for the vdisk.
  - Number of Sub-vdisks. For a RAID-10 or RAID-50 vdisk, optionally change the number of sub-vdisks that the vdisk should contain.
  - Chunk size. For RAID 1, 3, 5, 6, 10, or 50, optionally set the amount of contiguous data that is written to a vdisk member before moving to the next member of the vdisk. For RAID 50, this option sets the chunk size of each RAID-5 sub-vdisk. The chunk size of the RAID-50 vdisk is calculated as:  $\text{configured-chunk-size} \times (\text{subvdisk-members} - 1)$ . The default is 64KB.
2. Click **Next** to continue.

## Step 3: Selecting disks

Select disks to include in the vdisk. The Disk Selection Sets table has one row for each sub-*vdisk* in a RAID-10 or RAID-50 *vdisk*, or a single row for a *vdisk* having another RAID level. The table also has a SPARE row where you can assign dedicated spares to the *vdisk*. In each row, the Disks field shows how many disks you can, and have, assigned. As you select disks, the table shows the amount of storage space in the *vdisk*. For descriptions of storage-space color codes, see [About storage-space color codes](#) on page 26.

The Enclosures Front View table shows all disks in all enclosures. The Graphical tab shows disk information graphically; the Tabular tab shows disk information in a table. Disks you select are highlighted and color-coded to match the rows in the Disk Selection Sets table. Based on the type of disk you select first (SAS or SATA), only available disks of that type become selectable; you cannot mix SAS and SATA disks in a *vdisk*.

### To select disks and spares

1. Select disks to populate each *vdisk* row. When you have selected enough disks, a checkmark appears in the table's Complete field.
2. Optionally select up to four dedicated spares for the *vdisk*.
3. Click **Next** to continue.

## Step 4: Defining volumes

A *volume* is a logical subdivision of a *vdisk* and can be mapped to controller host ports for access by hosts. This type of volume provides the storage for a file system partition you create with your operating system or third-party tools. The storage system presents only volumes, not *vdisks*, to hosts.

You can create multiple volumes with the same base name, size, and default mapping settings. If you choose to define volumes in this step, you will define their mapping settings in the next step.

### To define volumes

1. Set the options:
  - Specify the number of volumes to create. If you do not want to define volumes now, enter **0**. After changing the value, press **Tab**.
  - Optionally change the volume size. The default size is the total space divided by the number of volumes.
  - Optionally change the base name for the volumes. A volume name is case sensitive and cannot already exist in a *vdisk*. A name cannot include a comma, double quote, or backslash.
2. Click **Next** to continue.

## Step 5: Setting the default mapping

Each volume has default host-access settings that were set when the volume was created; these settings are called the *default mapping*. The default mapping applies to any host that has not been explicitly mapped with different settings. Explicit mappings for a volume override the volume's default mapping.

You can change a volume's default mapping, and create, modify, or delete explicit mappings. A mapping can specify read-write, read-only, or no access through one or more controller host ports to a volume.

When a mapping specifies no access, the volume is *masked*. You can apply access privileges to one or more of the host ports on either controller. To maximize performance, it is recommended to map a volume to at least one host port on the controller that owns it. To sustain I/O in the event of controller failure, it is recommended to map to at least one host port on each controller.

Volume mapping settings are stored in disk metadata. If enough of the disks used by a volume are moved into a different enclosure, the volume's *vdisk* can be reconstructed and the mapping data is preserved.

### To specify the default mapping

1. Select **Map**.
2. Set the LUN that attached hosts can use to access the volume.
3. In the enclosure view or list, select controller host ports through which attached hosts can access the volume.

4. Select the access level that hosts will have to the volumes: read-write, read-only, or no-access (masked).
5. Click **Next** to continue.

## Step 6: Confirming vdisk settings

Confirm that the values listed in the wizard panel are correct.

- If they are not correct, click **Previous** to return to previous steps and make necessary changes.
- If they are correct, click **Finish** to apply the setting changes and finish the wizard.

## Creating a vdisk

To create a vdisk

1. In the Configuration View panel, right-click the system or **Vdisks** and then select **Provisioning > Create Vdisk**.
2. In the main panel set the options:
  - Vdisk name. Optionally change the default name for the vdisk. A vdisk name is case sensitive and cannot already exist in the system. A name cannot include a comma, double quote, or backslash.
  - Assign to. Optionally select a controller to be the preferred owner for the vdisk. The default, Auto, automatically assigns the owner to load-balance vdisks between controllers.
  - RAID Level. Select a RAID level for the vdisk.
  - Number of Sub-vdisks. For a RAID-10 or RAID-50 vdisk, optionally change the number of sub-vdisks that the vdisk should contain.
  - Chunk size. For RAID 1, 3, 5, 6, 10, or 50, optionally set the amount of contiguous data that is written to a vdisk member before moving to the next member of the vdisk. For RAID 50, this option sets the chunk size of each RAID-5 sub-vdisk. The chunk size of the RAID-50 vdisk is calculated as:  $configured\text{-}chunk\text{-}size \times (subvdisk\text{-}members - 1)$ . The default is 64KB.
  - Online Initialization. If this option is enabled, you can use the vdisk while it is initializing but because the verify method is used to initialize the vdisk, initialization takes more time. If this option is disabled, you must wait for initialization to complete before using the vdisk, but initialization takes less time. Online initialization is fault tolerant.
3. Select disks to include in the vdisk. Only available disks have checkboxes. The number of disks you can select is determined by the RAID level, and is specified in the Disk Selection Sets table. When you have selected enough disks, a checkmark appears in the table's Complete field.
4. Click **Create Vdisk**. If the task succeeds, the new vdisk appears in the Configuration View panel.

## Deleting vdisks

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△ **CAUTION:** Deleting a vdisk removes all of its volumes and their data.

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To delete vdisks

1. Verify that hosts are not accessing volumes in the vdisks that you want to delete.
2. In the Configuration View panel, either:
  - Right-click the system or **Vdisks** and then select **Provisioning > Delete Vdisks**.
  - Right-click a vdisk and select **Provisioning > Delete Vdisk**.
3. In the main panel, select the vdisks to delete. To select or clear all vdisks, toggle the checkbox in the heading row.
4. Click **Delete Vdisk(s)**. A confirmation dialog appears.
5. Click **Delete** to continue; otherwise, click **Cancel**. If you clicked Delete, a processing dialog appears. As vdisks are deleted they are removed from the table and from the Configuration View panel. When processing is complete a success dialog appears.
6. Click **OK**.

## Expanding a vdisk

You can expand the capacity of a vdisk by adding disks to it. Host I/O to the vdisk can continue while the expansion proceeds. You can then create or expand a volume to use the new free space, which becomes available when the expansion is complete. You can expand only one vdisk at a time. The RAID level determines whether the vdisk can be expanded and the maximum number of disks the vdisk can have.

---

 **NOTE:** Expansion can take hours or days to complete, depending on the vdisk's RAID level and size, disk speed, utility priority, and other processes running on the storage system. You can stop expansion only by deleting the vdisk.

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## Before expanding a vdisk

Back up the vdisk's data so that if you need to stop expansion and delete the vdisk, you can move the data into a new, larger vdisk.

### To expand a vdisk

1. In the Configuration View panel, right-click a vdisk and select **Provisioning > Expand Vdisk**. Information appears about the selected vdisk and all disks in the system.
  - In the Disk Selection Sets table, the number of empty slots in the vdisk's Disks field shows how many disks you can add to the vdisk.
  - In the enclosure view or list, only suitable available disks are selectable.
2. Select disks to add.
3. Click **Expand Vdisk**. A processing dialog appears.
4. Click **OK**. The expansion's progress is shown in the **View > Overview** panel.

## Managing global spares

You can designate a maximum of eight global spares for the system. If a disk in any redundant vdisk (RAID 1, 3, 5, 6, 10, 50) fails, a global spare is automatically used to reconstruct the vdisk. At least one vdisk must exist before you can add a global spare. A spare must have sufficient capacity to replace the smallest disk in an existing vdisk.

The vdisk remains in Critical status until the parity or mirror data is completely written to the spare, at which time the vdisk returns to Fault Tolerant status. For RAID-50 vdisks, if more than one sub-vdisk becomes critical, reconstruction and use of spares occur in the order sub-vdisks are numbered.

### To change the system's global spares

1. In the Configuration View panel, right-click the system and select **Provisioning > Manage Global Spares**. The main panel shows information about available disks in the system. Existing spares are labeled GLOBAL SP.
  - In the Disk Selection Sets table, the number of empty slots in the Disks field shows how many spares you can add.
  - In the enclosure view or list, only existing global spares and suitable available disks are selectable.
2. Select spares to remove, disks to add as spares, or both.
3. Click **Modify Spares**. If the task succeeds, the panel is updated to show which disks are now global spares.



## Creating a volume set

In a vdisk that has sufficient free space, you can create multiple volumes with the same base name, size, and default mapping settings.

### To create a volume set

1. In the Configuration View panel, right-click a vdisk and select **Provisioning > Create Volume Set**.
2. In the main panel, set the options:
  - Volume Set Base-name. Optionally change the base name for the volumes. The volume names will consist of the base name and a number that increments from 000. If a name in the series is already in use, the next name in the series is assigned. For example, for a two-volume set starting with Volume000, if Volume001 already exists, the second volume is named Volume002. A base name is case sensitive and cannot already be used by another vdisk. A name cannot include a comma, double quote, or backslash.
  - Total Volumes. Specify the number of volumes to create.
  - Size. Optionally change the volume size. The default size is the total space divided by the number of volumes.
  - Map. Select this option to change the default mapping for the volumes:
    - Access. Select the access level that hosts will have to the volumes.
    - LUN. If the access level is set to read-write or read-only, set a LUN for the first volume. The next available LUN is assigned to the next volume mapped through the same ports. For example, for a two-volume set starting with LUN 100, if 101 is already assigned to a volume mapped through the same ports, the second volume is assigned 102.
    - In the enclosure view or list, select controller host ports through which attached hosts can access the volumes.
3. Click **Apply**. If the task succeeds, the new volumes appear in the Configuration View panel.

## Creating a volume

You can add a volume to a vdisk that has sufficient free space, and define default mapping settings.

### To create a volume in a vdisk

1. In the Configuration View panel, right-click a vdisk and select **Provisioning > Create Volume**.
2. In the main panel, set the options:
  - Volume name. Optionally change the default name. A volume name is case sensitive and cannot already exist in a vdisk. A name cannot include a comma, double quote, or backslash.
  - Size. Optionally change the default size, which is all free space in the vdisk.
  - OpenVMS Volume. Select this option if an OpenVMS host will access the volume.
  - OpenVMS Volume UID. If OpenVMS Volume is selected, enter a number in the range 1–32767 to identify the volume to the host.
  - Map. Select this option to change the default mapping for the volume:
    - Access. Select the access level that hosts will have to the volume.
    - LUN. If the access level is set to read-write or read-only, set a LUN for the volume.
    - In the enclosure view or list, select controller host ports through which attached hosts can access the volume.
3. Click **Apply**. If the task succeeds, the new volume appears in the Configuration View panel.

## Deleting volumes


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△ **CAUTION:** Deleting a volume removes its mappings and deletes its data.

---

### To delete volumes

1. Verify that hosts are not accessing the volumes that you want to delete.
  2. In the Configuration View panel, either:
    - Right-click the system or **Vdisks** or a vdisk and then select **Provisioning > Delete Volumes**.
    - Right-click a volume and select **Provisioning > Delete Volume**.
  3. In the main panel, select the volumes to delete. To select or clear all volumes, toggle the checkbox in the heading row.
  4. Click **Delete Volume(s)**.
  5. Click **Delete** to continue; otherwise, click **Cancel**. If you clicked Delete, a processing dialog appears. As volumes are deleted they are removed from the table and from the Configuration View panel. When processing is complete a success dialog appears.
  6. Click **OK**.
- 

 **NOTE:** The system might be unable to delete a large number of volumes in a single operation. If you specified to delete a large number of volumes, verify that all were deleted. If some of the specified volumes remain, repeat the deletion on those volumes.

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## Changing a volume's default mapping

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△ **CAUTION:** Volume mapping changes take effect immediately. Make changes that limit access to volumes when the volumes are not in use. Be sure to unmount a mapped volume from a host system before changing the mapping's LUN.

---

### To view the default mapping

In the Configuration View panel, right-click a volume and select **Provisioning > Default Mapping**. The main panel shows the volume's default mapping:

- LUN. Volume identifier presented to the host.
- Access. Volume access type: read-write, read-only, no-access (masked), or not-mapped.
- Ports. Controller host ports through which the volume is mapped to the host.

### To modify the default mapping

1. Select **Map**.
2. Set the LUN and select the ports and access type.
3. Click **Apply**. A message specifies whether the change succeeded or failed.
4. Click **OK**. Each mapping that uses the default settings is updated.

### To delete the default mapping

1. Clear **Map**.
2. Click **Apply**. A message specifies whether the change succeeded or failed.
3. Click **OK**. Each mapping that uses the default settings is updated.

## Changing a volume's explicit mappings

---

- △ **CAUTION:** Volume mapping changes take effect immediately. Make changes that limit access to volumes when the volumes are not in use. Be sure to unmount a mapped volume from a host system before changing the mapping's LUN.
- 

### To view volume mappings

In the Configuration View panel, right-click a volume and select **Provisioning > Explicit Mappings**. The main panel shows the following information about the volume's mappings:

- Type. Explicit or Default. Settings for an explicit mapping override the default mapping.
- Host ID. WWPN or IQN.
- Name. Host name.
- Ports. Controller host ports through which the host is mapped to the volume.
- LUN. Volume identifier presented to the host.
- Access. Volume access type: read-write, read-only, no-access (masked), or not-mapped.

### To create an explicit mapping

1. In the Maps for Volume table, select a host.
2. Select **Map**.
3. Set the LUN and select the ports and access type.
4. Click **Apply**. A message specifies whether the change succeeded or failed.
5. Click **OK**. The mapping becomes Explicit with the new settings.

### To modify an explicit mapping

1. In the Maps for Volume table, select the Explicit mapping to change.
2. Set the LUN and select the ports and access type.
3. Click **Apply**. A message specifies whether the change succeeded or failed.
4. Click **OK**. The mapping settings are updated.

### To delete an explicit mapping

1. In the Maps for Volume table, select the Explicit mapping to delete.
2. Clear **Map**.
3. Click **Apply**. A message specifies whether the change succeeded or failed.
4. Click **OK**. The mapping returns to the Default mapping.

## Expanding a volume

You can expand a standard volume if its vdisk has free space and sufficient resources. Because volume expansion does not require I/O to be stopped, the volume can continue to be used during expansion.

### To expand a volume

1. In the Configuration View panel, right-click a standard volume and select **Tools > Expand Volume**.
2. In the main panel, specify the amount of free space to add to the volume.
3. Click **Expand Volume**. If the specified value exceeds the amount of free space in the vdisk, a dialog lets you expand the volume to the limit of free space in the vdisk. If the task succeeds, the volume's size is updated in the Configuration View panel.

## Creating multiple snapshots

You can select multiple volumes and immediately create a snapshot of each volume.


### To create multiple snapshots

1. In the Configuration View panel, right-click the system or **Vdisks** or a vdisk and then select **Provisioning > Create Snapshots**.
2. In the main panel, select each volume to take a snapshot of. To select or clear all volumes, toggle the checkbox in the heading row.
3. Click **Create Snapshots**. If the task succeeds, the snapshots appear in the Configuration View panel.

## Creating a snapshot

You can create a snapshot now or schedule the snapshot task.

---

 **NOTE:** The first time a snapshot is created of a standard volume, the volume is converted to a master volume and a snap pool is created in the volume's vdisk. The snap pool's size is 20% of the volume size or 10 GB, whichever is larger. Before creating or scheduling snapshots, verify that the vdisk has enough free space to contain the snap pool.

---

### To create a snapshot now

1. In the Configuration View panel, right-click a volume and select **Provisioning > Create Snapshot**.
2. In the main panel, select **Now**.
3. Optionally change the default name for the snapshot. A snapshot name is case sensitive and cannot already exist in a vdisk. A name cannot include a comma, double quote, or backslash.
4. Click **Create Snapshot**. If the task succeeds, the snapshot appears in the Configuration View panel.

### To schedule a create snapshot task

1. In the Configuration View panel, right-click a volume and select **Provisioning > Create Snapshot**.
2. In the main panel, select **Scheduled**.
3. Set the options:
  - Snapshot prefix. Optionally change the default prefix to identify snapshots created by this task. The prefix is case sensitive and cannot include a comma, double quote, or backslash. Automatically created snapshots are named *prefix\_s001* through *prefix\_s1023*.
  - Snapshots to Retain. Select the number of snapshots to retain. When the task runs, the retention count is compared with the number of existing snapshots:
    - If the retention count has not been reached, the snapshot is created.
    - If the retention count has been reached, the volume's oldest snapshot is unmapped, reset, and renamed to the next name in the sequence.
  - Start Schedule. Specify a date and a time in the future for the schedule to start running.
    - Date must use the format *yyyy-mm-dd*.
    - Time must use the format *hh:mm* followed by either AM, PM, or 24H (24-hour clock). For example, 13:00 24H is the same as 1:00 PM.
  - Recurrence. Specify how often the task should run. It is not recommended to set the interval to less than two minutes.
  - Time Constraint. Specify a time range within which the task should run.
  - Date Constraint. Specify days when the task should run.
  - End Schedule. Specify when the task should stop running.
4. Click **Schedule Snapshots**. If processing succeeds, the schedule is saved and can be viewed in the overview panel for the volume or system.

## Deleting a snapshot

When you delete a snapshot, all data uniquely associated with that snapshot is deleted and associated space in the snap pool is freed for use. Snapshots can be deleted in any order, irrespective of the order in which they were created.

---

△ **CAUTION:** Deleting a snapshot removes its mappings and deletes its data.

---

### To delete a snapshot

1. Verify that hosts are not accessing the snapshot that you want to delete.
2. In the Configuration View panel, right-click a snapshot and select **Provisioning > Delete Snapshot**.
3. In the main panel, select the snapshot to delete.
4. Click **Delete Snapshot(s)**.
5. Click **OK** to continue; otherwise, click **Cancel**. If you clicked OK, a processing dialog appears. When the snapshot is deleted it is removed from the table and from the Configuration View panel. When processing is complete a success dialog appears.
6. Click **OK**.

## Resetting a snapshot

Instead of taking a new snapshot of a volume, you can replace the data in a snapshot with the current data in the source volume. The snapshot's name and mapping settings are not changed. The snapshot data is stored in the source volume's snap pool.

---

△ **CAUTION:** To avoid data corruption, before resetting a snapshot it must be unmounted from hosts.

---

You can reset a snapshot now or schedule the reset task.

### To reset a snapshot now

1. Unmount the snapshot from hosts.
2. In the Configuration View panel, right-click a snapshot and select **Provisioning > Reset Snapshot**.
3. In the main panel, select **Now**.
4. Click **Reset Snapshot**. A message indicates whether the task succeeded or failed.
5. Optionally, remount the snapshot.

### To schedule a reset snapshot task

1. In the Configuration View panel, right-click a snapshot and select **Provisioning > Reset Snapshot**.
2. In the main panel, select **Scheduled**.
3. Set the options:
  - Start Schedule. Specify a date and a time in the future for the schedule to start running.
    - Date must use the format *yyyy-mm-dd*.
    - Time must use the format *hh:mm* followed by either AM, PM, or 24H (24-hour clock). For example, 13:00 24H is the same as 1:00 PM.
  - Recurrence. Specify how often the task should run. It is not recommended to set the interval to less than two minutes.
  - Time Constraint. Specify a time range within which the task should run.
  - Date Constraint. Specify days when the task should run.
  - End Schedule. Specify when the task should stop running.
4. Click **Reset Snapshot**. If the task succeeded, the schedule is saved and can be viewed in the overview panel for the snapshot or system.
5. Make a reminder to unmount the snapshot before the scheduled task runs.

## Creating a volume copy

With the appropriate license, you can copy a volume or a snapshot to a new standard volume. The destination volume must be in a vdisk owned by the same controller as the source volume. If the source volume is a snapshot, you can choose whether to include its modified data (data written to the snapshot since it was created). The resulting volume is completely independent of the source volume.

---

△ **CAUTION:** To avoid data corruption in the destination volume, before copying a snapshot's modified data either unmount the volume or otherwise ensure that there is no host I/O to the volume.

---

You can copy a volume now or schedule the copy task.

---

📖 **NOTE:** The first time a standard volume is copied, the volume is converted to a master volume and a snap pool is created in the volume's vdisk. The snap pool's size is 20% of the volume size or 10 GB, whichever is larger. Before creating or scheduling copies, verify that the vdisk has enough free space to contain the snap pool.

---

During a volume copy operation using snapshot modified data, the snapshot should be unmounted and cannot be accessed. Unmounting ensures that all data cached by the host is written to the snapshot; if the unmount is not performed at the host level prior to starting the volume copy, data may remain in host cache, and thus not be copied to the destination volume. As a precaution against inadvertently accessing the snapshot, the system also takes the snapshot offline, as shown by the Snapshot Overview panel. The snapshot becomes inaccessible in order to prevent any data corruption to the destination volume. The snapshot can be remounted once the volume copy is complete. The volume copy's progress is shown in the Volume Overview panel.

### To create a volume copy now

1. In the Configuration View panel, right-click a volume and select **Provisioning > Create Volume Copy**.
2. In the main panel, select **Now**.
3. Set the options:
  - **New Volume Name.** Optionally change the default name for the destination volume. A volume name is case sensitive and cannot already exist in a vdisk. A name cannot include a comma, double quote, or backslash.
  - **Residing On Vdisk.** Optionally change the destination vdisk.
  - **With Modified Data.** If the source volume is a snapshot, select this option to include the snapshot's modified data in the copy. Otherwise, the copy will contain only the data that existed when the snapshot was created.
4. Click **Copy the Volume**. The volume copy operation starts. While the operation is in progress, the destination volume is offline and its type is shown as "standard\*". If you unmounted a snapshot to copy its modified data, *wait* until processing is complete before you remount it. If the task succeeds, the destination volume's type becomes standard and the volume appears in the Configuration View panel.
5. Optionally map the volume to hosts.

### To schedule a volume copy task

1. In the Configuration View panel, right-click a volume and select **Provisioning > Create Volume Copy**.
2. In the main panel, select **Scheduled**.
3. Set the options:
  - **New Volume Prefix.** Optionally change the default prefix to identify volumes created by this task. The prefix is case sensitive and cannot include a comma, double quote, or backslash. Automatically created volumes are named *prefix\_c001* through *prefix\_c1023*.
  - **Residing On Vdisk.** Optionally change the destination vdisk.

- **With Modified Data.** If the source volume is a snapshot, select this option to include the snapshot's modified data in the copy. Otherwise, the copy will contain only the data that existed when the snapshot was created.
  - **Start Schedule.** Specify a date and a time in the future for the schedule to start running.
    - Date must use the format *yyyy-mm-dd*.
    - Time must use the format *hh:mm* followed by either AM, PM, or 24H (24-hour clock). For example, 13:00 24H is the same as 1:00 PM.
  - **Recurrence.** Specify how often the task should run. It is not recommended to set the interval to less than two minutes.
  - **Time Constraint.** Specify a time range within which the task should run.
  - **Date Constraint.** Specify days when the task should run.
  - **End Schedule.** Specify when the task should stop running.
4. Click **Schedule Volume Copy**. If the task succeeded, the schedule is saved and can be viewed in the overview panel for the volume or system.
  5. If you will copy snapshot modified data, make a reminder to unmount the snapshot before the scheduled task runs.

## Aborting a volume copy

You can cancel an in-progress volume copy operation. When the cancellation is complete, the destination volume is deleted.

### To abort a volume copy

1. In the Configuration View panel, right-click the source volume or the destination volume and then select **Provisioning > Abort Volume Copy**. The Volume Overview panel shows the operation's progress.
2. Click **Abort Volume Copy**. A message confirms that the operation has been aborted.
3. Click **OK**. The destination volume is removed from the Configuration View panel.

## Rolling back a volume

You can roll back (revert) the data in a volume to the data that existed when a specified snapshot was created. You also have the option of including its modified data (data written to the snapshot since it was created). For example, you might want to take a snapshot, mount it for read/write, and then install new software on the snapshot for testing. If the software installation is successful, you can roll back the volume to the contents of the modified snapshot.

---

### △ CAUTION:

- Before rolling back a volume you must unmount it from data hosts to avoid data corruption. If you want to include snapshot modified data in the roll back, you must also unmount the snapshot.
  - Whenever you perform a roll back, the data that existed on the volume is replaced by the data on the snapshot; that is, all data on the volume written since the snapshot was taken is lost. As a precaution, take a snapshot of the volume before starting a roll back.
- 

Only one roll back is allowed on the same volume at one time. Additional roll backs are queued until the current roll back is complete. However, after the roll back is requested, the volume is available for use as if the roll back has already completed.

During a roll back operation using snapshot modified data, the snapshot should be unmounted and cannot be accessed. Unmounting ensures that all data cached by the host is written to the snapshot; if the unmount is not performed at the host level prior to starting the roll back, data may remain in host cache, and thus not be rolled back to the master volume. As a precaution against inadvertently accessing the snapshot, the system also takes the snapshot offline, as shown by the Snapshot Overview panel. The snapshot becomes inaccessible in order to prevent any data corruption to the master volume. The snapshot can be remounted once the roll back is complete. The roll back's progress is shown in the Roll Back Volume panel.

## To roll back a volume

1. Unmount the volume from hosts.
2. If the roll back will include snapshot modified data, unmount the snapshot from hosts.
3. In the Configuration View panel, right-click a volume and select **Provisioning > Roll Back Volume**.
4. In the main panel, set the options:
  - For Volume.
  - From Snapshot Volume. Enter the name of the snapshot to roll back to.
  - **With Modified Data**. Select this option to include the snapshot's modified data in the roll back. Otherwise, the master volume will contain only the data that existed when the snapshot was created.
5. Click **Roll Back Volume**. The roll back starts. You can now remount the volume. The panel shows the roll back's progress.
6. When the roll back is complete, if you unmounted the snapshot you can remount it.

## Adding a host

### To add a host

1. Determine the host's WWPN or IQN.
2. In the Configuration View panel, right-click the system or **Hosts** and then select **Provisioning > Add Host**.
3. In the main panel set the options:
  - Host ID (WWN/IQN). Enter the host's WWPN or IQN.
  - Host Name. Optionally change the default name to one that helps you easily identify the host; for example, MailServer\_P1. A host name is case sensitive and cannot already exist in the system. A name cannot include a comma, double quote, or backslash.
  - Profile. Select the appropriate option that specifies whether the host allows use of LUN 0 for mappings:
    - Standard: LUN 0 can be assigned to a mapping. This is the default.
    - OpenVMS: LUN 0 cannot be assigned to a mapping.
    - HP-UX: LUN 0 can be assigned to a mapping and the host uses Flat Space Addressing.
4. Click **Add Host**. If the task succeeds, the new host appears in the Configuration View panel.

## Removing hosts

### To remove hosts

1. Verify that the hosts you want to remove are not accessing volumes.
2. In the Configuration View panel, either:
  - Right-click the system or **Hosts** and then select **Provisioning > Remove Hosts**.
  - Right-click a host and select **Provisioning > Remove Host**.
3. In the main panel, select the hosts to remove. To select or clear all hosts, toggle the checkbox in the heading row.
4. Click **Remove Host(s)**. A confirmation dialog appears.
5. Click **Remove** to continue; otherwise, click **Cancel**. If you clicked Remove, a processing dialog appears. If the task succeeds, the hosts are removed from the table and from the Configuration View panel. When processing is complete a success dialog appears.
6. Click **OK**.



## Changing a host's name

### To change a host's name

1. In the Configuration View panel, right-click a host and select **Provisioning > Rename Host**.
2. Enter a new name that helps you easily identify the host; for example, MailServer\_P1. A host name is case sensitive and cannot already exist in the system. A name cannot include a comma, double quote, or backslash.
3. Click **Modify Name**.

## Changing host mappings

For each volume that is mapped to the selected host, you can create, modify, and delete explicit mappings. To change a volume's default mapping, see [Changing a volume's default mapping](#) on page 50.

- 
- △ **CAUTION:** Volume mapping changes take effect immediately. Make changes that limit access to volumes when the volumes are not in use. Be sure to unmount a mapped volume from a host system before changing the mapping's LUN.
- 

### To view host mappings

In the Configuration View panel, right-click a host and select **Provisioning > Manage Host Mappings**. The main panel shows the following information about volumes mapped to the host:

- Type. Explicit or Default. Settings for an explicit mapping override the default mapping.
- Name. Volume name.
- Serial Number. Volume serial number.
- Ports. Controller host ports through which the volume is mapped to the host.
- LUN. Volume identifier presented to the host.
- Access. Volume access type: read-write, read-only, no-access (masked), or not-mapped.

### To create an explicit mapping

1. In the Maps for Host table, select the Default mapping to override.
2. Select **Map**.
3. Set the LUN and select the ports and access type.
4. Click **Apply**. A message specifies whether the change succeeded or failed.
5. Click **OK**. The mapping becomes Explicit with the new settings.

### To modify an explicit mapping

1. In the Maps for Host table, select the Explicit mapping to change.
2. Set the LUN and select the ports and access type.
3. Click **Apply**. A message specifies whether the change succeeded or failed.
4. Click **OK**. The mapping settings are updated.

### To delete an explicit mapping

1. In the Maps for Host table, select the Explicit mapping to delete.
2. Clear **Map**.
3. Click **Apply**. A message specifies whether the change succeeded or failed.
4. Click **OK**. The mapping returns to the Default mapping.

## Configuring CHAP

For iSCSI, you can use Challenge-Handshake Authentication Protocol (CHAP) to perform authentication between the initiator and target of a login request.

To perform this identification, a database of CHAP entries must exist on each device. Each CHAP entry can specify one name-secret pair to authenticate the initiator only (one-way CHAP) or two pairs to authenticate both the initiator and the target (mutual CHAP). For a login request from an iSCSI host to a storage system, the host is the initiator and the storage system is the target.

To enable or disable CHAP for all iSCSI hosts, see [Changing host interface settings](#) on page 37.

### To add or modify a CHAP entry

1. In the Configuration View panel, right-click **Hosts** or a specific host and then select **Provisioning > Configure CHAP**. If any CHAP entries exist, a table shows them by node name.
2. Optionally, select an entry whose name you want to change to create a new entry. The entry's values appear in the option fields.
3. Set the options:
  - Node Name (IQN). The initiator's IQN.
  - Secret. The secret that the target uses to authenticate the initiator. The secret is case sensitive and can include 12–16 bytes.
  - Name, if mutual CHAP. Optional; for mutual CHAP only. Specifies the target name, which is typically the target's IQN. The name is case sensitive, can include a maximum of 223 bytes, and must differ from the initiator name. Storage system port IQNs are shown on the Enclosure Overview panel (page 75).
  - Secret, if mutual CHAP. Optional; for mutual CHAP only. Specifies the secret that the initiator uses to authenticate the target. The secret is case sensitive, can include 12–16 bytes, and must differ from the initiator secret. A storage system's secret is shared by both controllers.
4. Click **Add/Modify Entry**. If the task succeeds, the new or modified entry appears in the CHAP entries table.

### To delete a CHAP entry

1. In the Configuration View panel, right-click **Hosts** or a specific host and then select **Provisioning > Configure CHAP**. If any CHAP entries exist, a table shows them by node name.
2. Select the entry to delete.
3. Click **Delete Entry**. If the task succeeds, the entry is removed from the CHAP entries table.

## Deleting schedules

### To delete task schedules

1. In the Configuration View panel, right-click the system or a volume or a snapshot and select **Provisioning > Delete Schedule**.
2. In the main panel, select the schedule to remove.
3. Click **Delete Schedule**. A confirmation dialog appears.
4. Click **Yes** to continue; otherwise, click **No**. If you clicked Yes, a processing dialog appears. If the task succeeds, the schedules are removed from the table and from the Configuration View panel. When processing is complete a success dialog appears.
5. Click **OK**.


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## 4 Using system tools

### Updating firmware

You can view the current versions of firmware in controller modules, expansion modules (in drive enclosures), and disks, and install new versions.

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 **TIP:** To ensure success of an online update, select a period of low I/O activity. This helps the update complete as quickly as possible and avoids disruptions to host and applications due to timeouts. Attempting to update a storage system that is processing a large, I/O-intensive batch job will likely cause hosts to lose connectivity with the storage system.

---

### Updating controller module firmware


A controller enclosure can contain one or two controller modules. In a dual-controller system, both controllers should run the same firmware version. You can update the firmware in each controller module by loading a firmware file obtained from the HP web download site, <http://www.hp.com/go/msa>. To install an HP ROM Flash Component or firmware Smart Component, follow the instructions on the HP web site; otherwise, to install a firmware binary file, follow the steps below.

If you have a dual-controller system and the Partner Firmware Update option is enabled, when you update one controller the system automatically updates the partner controller. If Partner Firmware Update is disabled, after updating software on one controller you must manually update the partner controller.

#### To update controller module firmware

1. Obtain the appropriate firmware file and download it to your computer or network.
2. If the system has a single controller, stop I/O to vdisks before starting the firmware update.
3. In the Configuration View panel, right-click the system and select **Tools > Update Firmware**. The tables titled Current Versions of Controller Module A and Current Versions of Controller Module B show the currently installed versions.
4. Click **Browse** and select the firmware file to install.
5. Click **Install Controller-Module Firmware File**. It takes approximately 10 minutes for the firmware to load and for the automatic restart to complete on the controller you are connected to. Wait for the progress messages to specify that the update has completed. If Partner Firmware Update is enabled, allow an additional 20 minutes for the partner controller to be updated.

---

 **WARNING!** Do not perform a power cycle or controller restart during a firmware update. If the update is interrupted or there is a power failure, the module might become inoperative. If this occurs, contact technical support. The module might need to be returned to the factory for reprogramming.

---

6. Verify that the proper firmware version appears for each controller module.

### Updating expansion module firmware

A drive enclosure can contain one or two expansion modules. Each expansion module contains an enclosure management processor (EMP). All modules of the same model should run the same firmware version. You can update the firmware in each expansion module by loading a firmware file obtained from the HP web download site, <http://www.hp.com/go/msa>. To install an HP ROM Flash Component or firmware Smart Component, follow the instructions on the HP web site; otherwise, to install a firmware binary file, follow the steps below.

## To update expansion module firmware

1. Obtain the appropriate firmware file and download it to your computer or network.
2. Stop I/O to vdisks before starting the firmware update.
3. In the Configuration View panel, right-click the system and select **Tools > Update Firmware**. The table titled Current Versions of All Expansion Modules (EMPs) shows the currently installed versions.
4. Select the expansion modules to update.
5. Click **Browse** and select the firmware file to install.
6. Click **Install Expansion-Module Firmware File**. It typically takes 6.5 minutes to update an EMP in each MSA70 drive enclosure, or 1.5 minutes to load an EMP in each MSA2000 12-drive enclosure. Wait for the progress messages to specify that the update has completed.

---

**⚠ WARNING!** Do not perform a power cycle or controller restart during the firmware update. If the update is interrupted or there is a power failure, the module might become inoperative. If this occurs, contact technical support. The module might need to be returned to the factory for reprogramming.

---

7. If you updated firmware in an HP MSA70 drive enclosure, power cycle the enclosure to complete the update process.
8. Verify that the proper firmware version appears for each updated expansion module.

## Updating disk firmware

You can update disk firmware by loading a firmware file obtained from HP web download site, <http://www.hp.com/go/msa>, or from the disk manufacturer. To install an HP ROM Flash Component or firmware Smart Component, follow the instructions on the HP web site; otherwise, to install a firmware binary file, follow the steps below.

A dual-ported disk can be updated from either controller. A single-ported disk that is in a vdisk or is a dedicated spare for a vdisk must be updated from the controller that owns the vdisk. Attempting to update a single-ported disk from the non-owning controller will not cause any change to the disk.

Disks in single-ported MSA70 drive enclosures must be updated from the controller to which the MSA70 is connected.

---

**📋 NOTE:** Disks of the same model in the storage system must have the same firmware revision.

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## To update disk firmware

1. Obtain the appropriate firmware file and download it to your computer or network.
2. Check the disk manufacturer's documentation to determine whether disks must be power cycled after firmware update.
3. Stop I/O to the storage system before starting the firmware update.
4. In the Configuration View panel, right-click the system and select **Tools > Update Firmware**. The table titled Current Versions (Revisions) of All Disk Drives shows the currently installed versions.
5. Select the disks to update.
6. Click **Install Disk Firmware File**. It typically takes several minutes for the firmware to load. Wait for the progress messages to specify that the update has completed.


---

**⚠ WARNING!** Do not power cycle enclosures or restart a controller during the firmware update. If the update is interrupted or there is a power failure, the disk might become inoperative. If this occurs, contact technical support.

---

7. If the updated disks must be power cycled:
  - a. Shut down both controllers; see [Restarting or shutting down controllers](#) on page 62.
  - b. Power cycle all enclosures as described in your product's user guide.

---

 **NOTE:** If you loaded firmware to a Seagate 750-Gbyte Barracuda ES SATA drive, after spin-up it will be busy for about 50 seconds completing its update. Then it will be ready for host I/O.

---


8. Verify that each disk has the correct firmware revision.

## Saving logs

In preparation for contacting technical support, you can save debug-log data to a file. The file will contain the following data:

- Device status summary, which includes basic status and configuration data for the system
- Each controller's event log
- Each controller's debug log
- Each controller's boot log, which shows the startup sequence
- Critical error dumps from each controller, if critical errors have occurred
- Management Controller traces

---

 **NOTE:** The controllers share one memory buffer for gathering log data and for loading firmware. Do not try to perform more than one save-logs operation at a time, or to perform a firmware-update operation while performing a save-logs operation. Doing so will display a "buffer busy" error.

---

### To save logs

In the Configuration View panel, right-click the system and select **Tools > Save Logs**.

1. In the main panel:
  - a. Enter your name, email address, and phone number so support personnel will know who provided the log data.
  - b. Enter comments, describing the problem and specifying the date and time when the problem occurred. This information helps support personnel when they analyze the log data.
2. Click **Save Logs**. Log data is collected, which takes several minutes.
3. When prompted to open or save the log file, click **Save**.
  - If you are using Firefox and have a download directory set, the file `store.logs` is saved there.
  - Otherwise, you are prompted to specify the file location and name. The default file name is `store.logs`. You can change the name to be more specific, but keep the `.logs` extension.

## Resetting a host port

Making a configuration or cabling change on a host might cause the storage system to stop accepting I/O requests from that host. For example, this problem can occur after moving host cables from one HBA to another on the host. To fix such a problem you might need to reset controller host ports (channels).

For a Fibre Channel host port configured to use FC-AL (loop) topology, a reset issues a loop initialization primitive (LIP). For a SAS host port, a reset issues a `COMINIT/COMRESET` sequence.

### To reset a host port

1. In the Configuration View panel, right-click the system and select **Tools > Reset Host Port**.
2. Select the port to reset. For example, to reset controller A port 1, select **A1**.
3. Click **Reset Host Port**.

## Rescanning disk channels

A rescan forces a rediscovery of disks and enclosures in the storage system. If two Storage Controllers are online, rescan also reassigns the enclosure IDs of attached enclosures based on controller A's enclosure cabling order. A manual rescan may be needed after system power-up to display enclosures in the proper order. A manual rescan temporarily pauses all I/O processes, then resumes normal operation. It can take up to two minutes for the enclosure IDs to be corrected.

A manual rescan is not needed after inserting or removing disks; the controllers automatically detect these changes. When disks are inserted they are detected after a short delay, which allows the disks to spin up.

### To rescan disk channels

1. Verify that both controllers are operating normally.
2. In the Configuration View panel, right-click the system and select **Tools > Rescan Disk Channels**.
3. Click **Rescan**.

## Clearing disk metadata

Each disk has metadata that identifies whether the disk is a member of a vdisk, and identifies other members of that vdisk. If a disk's metadata says the disk is a member of a vdisk but other members' metadata say the disk isn't a member, the disk becomes a *leftover*. The system overview and enclosure overview pages show the disk's How Used value as LEFTOVR. A leftover disk's Fault/UID LED is illuminated amber.

Before you can use the disk in a new vdisk or as a spare, you must clear the disk's metadata.

### To clear metadata from leftover disks

1. In the Configuration View panel, right-click the system and then select **Tools > Clear Disk Metadata**.
2. In the main panel, select disks to clear metadata from.
3. Click **Clear Metadata**. When processing is complete a success dialog appears.
4. Click **OK**.

## Restarting or shutting down controllers

You can restart the processors in a controller module when SMU informs you that you have changed a configuration setting that requires restarting or when the controller is not working properly. Shut down the processors in a controller module before you remove it from an enclosure, or before you power off its enclosure for maintenance, repair, or a move.

A restart can be performed on either the Storage Controller processor or the Management Controller processor. A shut down affects both processors.

## Restarting

If you restart a Storage Controller, it attempts to shut down with a proper failover sequence, which includes stopping all I/O operations and flushing the write cache to disk, and then the controller restarts. The Management Controller is not restarted so it can provide status information to external interfaces.

If you restart a Management Controller, communication with it is lost until it successfully restarts. If the restart fails, the partner MC remains active with full ownership of operations and configuration information.

---


△ **CAUTION:** If you restart both controller modules, you and users lose access to the system and its data until the restart is complete.

---

### To perform a restart

1. In the Configuration View panel, right-click the local system and select Configuration > Shut Down or Restart Controller.
2. In the main panel, set the options:
  - Select the **Restart** operation.
  - Select the type of controller processor to restart.
  - Select whether to restart the processor in controller A, B, or both.
3. Click **Restart** now. A confirmation dialog appears.
4. Click **Yes** to continue; otherwise, click **No**. If you clicked Yes, a second confirmation dialog appears.
5. Click **Yes** to continue; otherwise, click **No**. If you clicked Yes, a message describes restart activity.

---

 **NOTE:** If an iSCSI port is connected to a Microsoft Windows host, the following event is recorded in the Windows event log: A connection to the target was lost, but Initiator successfully reconnected to the target.

---

## Shutting down

Shutting down the Storage Controller in a controller module ensures that a proper failover sequence is used, which includes stopping all I/O operations and writing any data in write cache to disk. If the Storage Controller in both controller modules is shut down, hosts cannot access the system's data. Perform a shut down before removing a controller module or powering down the system.

---

△ **CAUTION:** You can continue to use the CLI when either or both Storage Controllers are shut down, but information shown might be invalid.

---

### To perform a shut down

1. In the Configuration View panel, right-click the local system and select **Configuration > Shut Down or Restart Controller**.
2. In the main panel, set the options:
  - Select the **Shut down** operation.
  - Select whether to restart the processor in controller A, B, or both.
3. Click **Shut down now**. A confirmation dialog appears.
4. Click **Yes** to continue; otherwise, click **No**. If you clicked Yes, a second confirmation dialog appears.
5. Click **Yes** to continue; otherwise, click **No**. If you clicked Yes, a message describes shutdown activity.

---

 **NOTE:** If an iSCSI port is connected to a Microsoft Windows host, the following event is recorded in the Windows event log: Initiator failed to connect to the target.

---

## Verifying a vdisk

If you suspect that a redundant (mirror or parity) vdisk has a problem, you can run the Verify utility to check the vdisk's integrity. For example, if the storage system was operating outside the normal temperature range, you might want to verify its vdisks. The Verify utility checks whether the redundancy data in the vdisk is consistent with the user data in the vdisk. For RAID 3, 5, 6, and 50, the utility checks all parity blocks to find data-parity mismatches. For RAID 1 and 10, the utility compares the primary and secondary disks to find data inconsistencies.

Verification can last over an hour, depending on the size of the vdisk, the utility priority, and the amount of I/O activity. When verification is complete, the number of inconsistencies found is reported with event code 21 in the event log. Such inconsistencies can indicate that a disk in the vdisk is going bad. For information about identifying a failing disk, use the SMART option (see [Configuring SMART](#) on page 39). You can use a vdisk while it is being verified.

If too many utilities are running for verification to start, either wait until those utilities have completed and try again, or abort a utility to free system resources. If you abort verification, you cannot resume it; you must start it over.

### To verify a vdisk

1. In the Configuration View panel, right-click a redundant vdisk and select **Tools > Verify Vdisk**.
2. Click **Start Verify Utility**. A message confirms that verification has started.
3. Click **OK**. The panel shows the verification's progress.

### To abort vdisk verification

1. In the Configuration View panel, right-click a redundant vdisk and select **Tools > Verify Vdisk**.
2. Click **Abort Verify Utility**. A message confirms that verification has been aborted.
3. Click **OK**.

## Scrubbing a vdisk

The Background Scrub option (see [Configuring background scrub](#) on page 41) automatically checks all vdisks for disk defects. If this option is disabled, you can still perform a scrub on a selected vdisk.

You can use the Scrub utility to analyze a vdisk's disks to detect, report, and store information about disk defects. Vdisk-level errors reported include: hard errors, medium errors, and bad block replacements (BBRs). Disk-level errors reported include: metadata read errors, SMART events during scrub, bad blocks during scrub, and new disk defects during scrub. For RAID 3, 5, 6, and 50, the utility checks all parity blocks to find data-parity mismatches. For RAID 1 and 10, the utility compares the primary and secondary disks to find data inconsistencies. For NRAID and RAID 0, the utility checks for media errors.

You can use a vdisk while it is being scrubbed. A scrub can last over an hour, depending on the size of the vdisk, the utility priority, and the amount of I/O activity. However, a foreground scrub is typically faster than a background scrub. When a scrub is complete, the number of errors found is reported with event code 207 in the event log.

### To scrub a vdisk

1. In the Configuration View panel, right-click a vdisk and select **Tools > Media Scrub Vdisk**.
2. Click **Start Media Scrub Utility**. A message confirms that the scrub has started.
3. Click **OK**. The panel shows the scrub's progress.

### To abort a vdisk scrub

1. In the Configuration View panel, right-click a vdisk and select **Tools > Media Scrub Vdisk**.
2. Click **Abort Media Scrub Utility**. A message confirms that the scrub has been aborted.
3. Click **OK**.



## Removing a vdisk from quarantine

A previously fault-tolerant vdisk becomes *quarantined* when not all of its disks are detected after a restart or rescan. A quarantined vdisk is shown with health Critical and status QTCR or QTOF. Quarantine isolates the vdisk from host access, and prevents the storage system from making the vdisk critical and starting reconstruction when disks are “missing” for these reasons:


- Slow to spin up after system power-up
- Not properly seated in their slots
- In an powered-off enclosure
- Inserted from a different system and contains old metadata

The vdisk can be fully recovered if the missing disks can be restored. Make sure that no disks have been inadvertently removed and that no cables have been unplugged. Sometimes not all disks in the vdisk power up. Check that all enclosures have restarted after a power failure. If these problems are found and then fixed, the vdisk recovers and no data is lost.


The quarantined vdisk's disks are “write locked,” and the vdisk is not available to hosts until the vdisk is removed from quarantine. The system waits indefinitely for the missing disks. If the disks are found, the system automatically removes the vdisk from quarantine. If the disks are never found because they have been removed or have failed, you must manually remove the vdisk from quarantine.

If the missing disks cannot be restored (for example, a failed disk), you can remove the vdisk from quarantine to restore operation in some cases. If you remove from quarantine a vdisk that is not missing too many disks, its status changes to critical. Then, if spares of the appropriate size are available, reconstruction begins.

---

 **NOTE:** After you remove the vdisk from quarantine, make sure that a spare disk is available to let the vdisk reconstruct.

---

 **CAUTION:** If the vdisk does not have enough disks to continue operation, when the vdisk is removed from quarantine it goes offline and its data cannot be recovered.

---

### To remove a vdisk from quarantine

1. In the Configuration View panel, right-click a quarantined vdisk and select **Tools > Dequarantine Vdisk**.
2. Click **Dequarantine Vdisk**. Depending on the number of disks that remain active in the vdisk, its health might change to Degraded (RAID 6 only) and its status changes to FTOL, CRIT, or FTDN.







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## 5 Viewing system status

### Viewing information about the system

In the Configuration View panel, right-click the system and select **View > Overview**. The System Overview table shows:

- The system's health:
  -  OK. The system is operating normally.
  -  Degraded.
  -  Fault.
  -  Unknown. At least one component is degraded or has a fault.
- The system's total storage space
- The health, quantity, and storage space of enclosures, disks, and vdisks
- The quantity and storage space of volumes and snap pools
- The quantity of snapshots and task schedules
- Configuration limits, licenses, and versions of controller firmware and hardware

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 **NOTE:** If an I/O module in an MSA70 drive enclosure has a firmware revision below 2.18, the enclosure's health is shown as degraded and the health reason identifies the I/O module that needs to be updated.

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For descriptions of storage-space color codes, see [About storage-space color codes](#) on page 26.

Select a component to see more information about it.

### System properties

When you select the System component a table shows the system's health, redundancy mode and status, name, contact, location, information (description), vendor name, product ID, product brand, SCSI vendor ID, and supported locales (languages).

### Enclosure properties

When you select the Enclosure component a table shows each enclosure's health, ID, WWN, vendor, model, and quantity of disk slots.

### Disk properties

When you select the Disks component a table shows each disk's health, enclosure ID, slot number, serial number, vendor, model, firmware revision, type, usage, status, and size.

### Vdisk properties

When you select the Vdisks component a table shows each vdisk's health, name, size, free space, RAID level, status, and disk type.

### Volume properties

When you select the Volumes component a table shows each volume's name, serial number, size, and vdisk name.

### Snap-pool properties

When you select the Snap Pools component a table shows each snap pool's name, serial number, size, free space, master volumes, snapshots, and vdisk name.

## Snapshot properties

When you select the Snapshots component a table shows each snapshot's name, serial number, source volume, snap-pool name, amounts of snap data, unique data, and shared data, and vdisk name.

- Snap data is the total amount of data associated with the specific snapshot (data copied from a source volume to a snapshot and data written directly to a snapshot).
- Unique data is the amount of data that has been written to the snapshot since the last snapshot was taken. If the snapshot has not been written or is deleted, this value is zero bytes.
- Shared data is the amount of data that is potentially shared with other snapshots and the associated amount of space that will be freed if the snapshot is deleted. This represents the amount of data written directly to the snapshot. It also includes data copied from the source volume to the storage area for the oldest snapshot, since that snapshot does not share data with any other snapshot. For a snapshot that is not the oldest, if the modified data is deleted or if it had never been written to, this value is zero bytes.

## Schedule properties

When you select the Schedules component a table shows each schedule's name, specification, status, next run time, task type, task status, and task state.

A second table shows details including the last error message (if any), source volume name and serial number, prefix, number of times run, and the last item created.

## Configuration limits

When you select the Configuration Limits component a table shows the maximum quantities of vdisks, volumes, LUNs, disks, and host ports that the system supports.

## Licensed features

When you select the Licensed Features component a table shows the status of licensed features.




## Version properties

When you select the Versions component a table shows the versions of firmware and hardware in your system.


## Viewing the system event log

In the Configuration View panel, right-click the system and select **View > Event Log**. The System Events panel shows the 400 most recent events that have been logged by either controller. All events are logged, regardless of event-notification settings. Click the buttons above the table to view all events, or only critical, warning, or informational events.

The event log table shows the following information:

- Severity.
  -  Critical. Alerts you that the system or a vdisk has a failure that requires *immediate* attention.
  -  Warning. Warns you that the system or a vdisk has a problem that you should correct as soon as possible.
  -  Informational. Informs you that either a change was made to the system or a problem occurred that the system corrected; no action is required.
- Time. Date and time when the event occurred, in the format *yyyy-mm-dd hh:mm:ss*. Time stamps have one-second granularity.
- Event ID. An identifier for the event. The prefix A or B identifies the controller that logged the event.
- Code. Event code that helps you and support personnel diagnose problems. For event-code descriptions and recommended actions, see the [Event code reference](#) appendix.
- Message. Information about the event.

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 **NOTE:** If you are having a problem with the system or a vdisk, check the event log before calling technical support. Event messages might enable you to resolve the problem.

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When reviewing events, do the following:

1. For any critical or warning events, look for recommended actions in the [Event code reference](#) appendix. Identify the primary events and any that might be the cause of the primary event. For example, an over-temperature event could cause a disk failure.
2. Review the event log for the controller that reported the critical/warning event by viewing the event log by controller. Locate the critical/warning events in the sequence. Repeat this step for the other controller if necessary.
3. Review the events that occurred before and after the primary event. During this review you are looking for any events that might indicate the cause of the critical/warning event. You are also looking for events that resulted from the critical/warning event, known as secondary events.
4. Review the events following the primary and secondary events. You are looking for any actions that might have already been taken to resolve the problems reported by the events.

## Viewing information about all vdisks

In the Configuration View panel, right-click **Vdisks** and select **View > Overview**. The Vdisks Overview table shows the overall health, quantity, capacity, and space usage of existing vdisks. For descriptions of storage-space color codes, see [About storage-space color codes](#) on page 26.

For each vdisk, the Vdisks table shows the following details:

- Health.
  -  OK. The vdisk is online with all disks working.
  -  Degraded. The vdisk is being reconstructed, as shown by its Current Job property; or, a RAID-6 vdisk has degraded performance due to one missing disk but remains fault tolerant. You can use a degraded RAID-6 vdisk but resolve the problem as soon as possible.
  -  Fault. The vdisk can perform I/O functions for hosts but is not fault tolerant. Review the status information and take the appropriate action, such as replacing a disk. You can use the vdisk but resolve the problem as soon as possible.
  -  Unknown.
- Name. Vdisk name.
- Size. Total storage space in the vdisk.
- Free. Available space in the vdisk.
- RAID. RAID level of the vdisk and all of its volumes.
- Status.
  - CRIT: The vdisk is online, however some disks are down and the vdisk is not fault tolerant.
  - FTDN: The vdisk is online and fault tolerant, however some of the disks are down.
  - FTOL: The vdisk is online and fault tolerant.
  - OFFL: The vdisk is offline because it is using offline initialization, or because disks are down and data may be lost.
  - QTCR: The vdisk is in a critical state and has been quarantined because some disks are missing.
  - QTOF: The vdisk is offline and has been quarantined because some disks are missing.
  - UP: The vdisk is online and does not have fault-tolerant attributes.
- Disk Type. SAS (dual port), SAS-S (single port), SATA (dual port), or SATA-S (single port).
- Preferred Owner. Controller that owns the vdisk and its volumes during normal operation.

- Current Owner. Either the preferred owner during normal operation or the partner controller when the preferred owner is offline.
- Disks.
- Spares.

## Viewing information about a vdisk

In the Configuration View panel, right-click a vdisk and select **View > Overview**. The Vdisks Overview table shows:





- The overall health, capacity, and space usage of the vdisk
- The overall health, quantity, capacity, and space usage of disks in the vdisk
- The quantity, capacity, and space usage of volumes in the vdisk
- The quantity, capacity, and space usage of snap pools in the vdisk

For descriptions of storage-space color codes, see [About storage-space color codes](#) on page 26.

Select a component to see more information about it.

## Vdisk properties

When you select the Vdisk component, the Properties for *Vdisk* table shows:

- Health.
  -  OK. The vdisk is online with all disks working.
  -  Degraded. The vdisk is being reconstructed, as shown by its Current Job property; or, a RAID-6 vdisk has degraded performance due to one missing disk but remains fault tolerant. You can use a degraded RAID-6 vdisk but resolve the problem as soon as possible.
  -  Fault. The vdisk can perform I/O functions for hosts but is not fault tolerant. Review the status information and take the appropriate action, such as replacing a disk. You can use the vdisk but resolve the problem as soon as possible.
  -  Unknown.
- Health Reason. Shows more information about the vdisk's status.
- Name.
- Size. Total storage space in the vdisk.
- Free. Available space in the vdisk.
- Current Owner. Either the preferred owner during normal operation or the partner controller when the preferred owner is offline.
- Preferred Owner. Controller that owns the vdisk and its volumes during normal operation.
- Serial Number.
- RAID. RAID level of the vdisk and all of its volumes.
- Disks.
- Spares.
- Chunk Size.
  - For RAID levels except RAID 50, the configured chunk size for the vdisk.
  - For RAID 50, the vdisk chunk size calculated as:  $configured\_chunk\_size \times (subvdisk\_members - 1)$ . For a vdisk configured to use 32-KB chunk size and 4-disk sub-vdisks, the value would be 96K (32KB x 3).
- Created.
- Minimum Disk Size. Smallest disk in the vdisk.
- Status.
  - CRIT: The vdisk is online, however some disks are down and the vdisk is not fault tolerant.
  - FTDN: The vdisk is online and fault tolerant, however some of the disks are down.
  - FTOL: The vdisk is online and fault tolerant.





- OFFL: The vdisk is offline because it is using offline initialization, or because disks are down and data may be lost.
- QTCR: The vdisk is in a critical state and has been quarantined because some disks are missing.
- QTOF: The vdisk is offline and has been quarantined because some disks are missing.
- UP: The vdisk is online and does not have fault-tolerant attributes.
- Current Job. If a utility is running on the vdisk, this field shows the utility's name and progress.

## Disk properties

When you select the Disks component, two tables appear. The Disk Sets table shows:

- Total Space. Total storage space in the vdisk.
- Type. For RAID 10 or RAID 50, the sub-vgdisk that the disk is in; for other RAID levels, the disk's RAID level; or spare.
- Disk Type. SAS (dual port), SAS-S (single port), SATA (dual port), or SATA-S (single port).
- Disks.
- Size.

The Enclosures Front View table has two tabs. The Tabular tab shows:

- Health. Shows whether the disk is healthy or has a problem.
  -  OK. The disk is operating normally.
  -  Fault. The disk has failed.
  -  Degraded. The disk's operation is degraded.
  -  Unknown.
- Name. System-defined disk name using the format *Disk-enclosure-number.disk-slot-number*.
- Type. SAS (dual port), SAS-S (single port), SATA (dual port), or SATA-S (single port).
- State. Shows how the disk is used:

- AVAIL: Available
- GLOBAL SP: Global spare
- LEFTOVR: Leftover
- VDISK: Used in a vdisk
- VDISK SP: Spare assigned to a vdisk

Also shows any job running on the disk:

- EXPD: The vdisk is being expanded
- INIT: The vdisk is being initialized
- RCON: The vdisk is being reconstructed
- VRFY: The vdisk is being verified
- VRSC: The vdisk is being scrubbed
- Size.
- Enclosure. Enclosure name.
- Serial Number. Disk serial number.
- Status. Up (operational) or Not Present.

The Graphical tab shows the locations of the vdisk's disks in system enclosures and each disk's Health and State.

## Volume properties

When you select the Volumes component, the Volumes table shows:

- The volume's name, serial number, and size
- The name of the vdisk containing the volume

## Snap-pool properties

When you select the Snap Pools component, the Snap Pools table shows:

- The snap pool's name, serial number, size, and free space
- The quantity of master volumes and snapshots associated with the snap pool
- The name of the vdisk containing the snap pool

## Viewing information about a volume

In the Configuration View panel, right-click a volume and select **View > Overview**. The Volume Overview table shows:

- The capacity and space usage of the volume
- The quantity of mappings for the volume
- The quantity of task schedules for the volume

For descriptions of storage-space color codes, see [About storage-space color codes](#) on page 26.

Select a component to see more information about it.

## Volume properties

When you select the Volume component, the Properties for *Volume* table shows:

- Vdisk Name. Name of the vdisk that the volume is in.
- Name.
- Size.
- Preferred Owner. Controller that owns the vdisk and its volumes during normal operation.
- Current Owner. Either the preferred owner during normal operation or the partner controller when the preferred owner is offline.
- Serial Number.
- Cache Write Policy. Write-back or write-through. See [Using write-back or write-through caching](#) on page 19.
- Cache Optimization. Standard or super-sequential. See [Optimizing read-ahead caching](#) on page 19.
- Read Ahead Size. See [Optimizing read-ahead caching](#) on page 19.
- Type. Standard volume, master volume, or snapshot.
- Progress. If the volume is being created by a volume-copy operation, the percent complete.
- Volume Description. For OpenVMS, a numeric value (set in SMU) that identifies the volume to an OpenVMS host. For HP-UX, a text value (set in-band by a host application) that identifies the volume. Blank if not set.

## Mapping properties

When you select the Maps component, the Maps for *Volume* table shows:

- Type. Explicit or Default. Settings for an explicit mapping override the default mapping.
- Host ID. WWPN or IQN.
- Name. Host name.
- Ports. Controller host ports through which the volume is mapped to the host.
- LUN. Volume identifier presented to the host.
- Access. Volume access type: read-write, read-only, no-access (masked), or not-mapped.



## Schedule properties

If any schedules exist for this volume, when you select the Schedules component, the Schedules table shows information about each schedule. For the selected schedule, the Schedule Details table shows:

- Schedule Name.
- Schedule Specification.
- Schedule Status.
- Next Time.
- Task Type.
- Task Status.
- Task State.
- Source Volume.
- Source Volume Serial.
- Prefix.
- Count.
- Last Created.

## Viewing information about a snapshot

In the Configuration View panel, right-click a snapshot and select **View > Overview**. The Snapshot Overview table shows:

- The capacity and space usage of the snapshot
- The quantity of mappings for the snapshot
- The quantity of task schedules for the snapshot

For descriptions of storage-space color codes, see [About storage-space color codes](#) on page 26.

Select a component to see more information about it.

## Snapshot properties

When you select the Snapshot component, the Properties for Snapshot table shows:

- Vdisk Name.
- Serial Number. Snapshot serial number.
- Name. Snapshot name.
- Creation Date/Time.
- Status.
- Status-Reason.
- Master Volume Name. Name of the volume that the snapshot was taken of.
- Snap-pool Name.
- Snap Data. The total amount of data associated with the specific snapshot (data copied from a source volume to a snapshot and data written directly to a snapshot).
- UniqueData. The amount of data that has been written to the snapshot since the last snapshot was taken. If the snapshot has not been written or is deleted, this value is zero bytes.
- SharedData. The amount of data that is potentially shared with other snapshots and the associated amount of space that will be freed if the snapshot is deleted. This represents the amount of data written directly to the snapshot. It also includes data copied from the source volume to the storage area for the oldest snapshot, since that snapshot does not share data with any other snapshot. For a snapshot that is not the oldest, if the modified data is deleted or if it had never been written to, this value is zero bytes.

## Mapping properties

When you select the Maps component, the Maps for *Volume* table shows:

- Type. Explicit or Default. Settings for an explicit mapping override the default mapping.
- Host ID. WWPN or IQN.
- Name. Host name.
- Ports. Controller host ports through which the volume is mapped to the host.
- LUN. Volume identifier presented to the host.
- Access. Volume access type: read-write, read-only, no-access (masked), or not-mapped.

## Schedule properties

If any schedules exist for the snapshot, when you select the Schedules component, the Schedules table shows information about each schedule. For the selected schedule, the Schedule Details table shows:

- Schedule Name.
- Schedule Specification.
- Schedule Status.
- Next Time.
- Task Type.
- Task Status.
- Task State.
- Source Volume.
- Source Volume Serial.
- Prefix.
- Count.
- Last Created.

## Viewing information about all hosts

In the Configuration View panel, right-click **Hosts** and select **View > Overview**. The Hosts table shows the quantity of hosts configured in the system.

For each host, the Hosts Overview table shows the following details:

- Host ID. WWPN or IQN.
- Name.
- Discovered. If the host was discovered and its entry was automatically created, Yes. If the host entry was manually created, No.
- Mapped. If volumes are mapped to the host, Yes; otherwise, No.
- Profile. If the host type is Standard, LUN 0 can be assigned to a mapping. If the host type is OpenVMS, LUN 0 cannot be assigned to a mapping. If the host type is HP-UX, LUN 0 can be assigned to a mapping and the host uses Flat Space Addressing.

## Viewing information about a host

In the Configuration View panel, right-click a host and select **View > Overview**. The Host Overview table shows:

- Host properties
- The quantity of mappings for the host

Select a component to see more information about it.

## Host properties

When you select the Host component, the Properties for *Host* table shows:

- Host ID. WWPN or IQN.
- Name.
- Discovered. If the host was discovered and its entry was automatically created, Yes. If the host entry was manually created, No.
- Mapped. If volumes are mapped to the host, Yes; otherwise, No.
- Profile. If the host type is Standard, LUN 0 can be assigned to a mapping. If the host type is OpenVMS, LUN 0 cannot be assigned to a mapping. If the host type is HP-UX, LUN 0 can be assigned to a mapping and the host uses Flat Space Addressing.

## Mapping properties

When you select the Maps component, the Maps for *Host* table shows:

- Type. Explicit or Default. Settings for an explicit mapping override the default mapping.
- Name. Volume name.
- Serial Number. Volume serial number.
- Ports. Controller host ports through which the volume is mapped to the host.
- LUN. Volume identifier presented to the host.
- Access. Volume access type: read-write, read-only, no-access (masked), or not-mapped.

## Viewing information about an enclosure

In the Configuration View panel, right-click an enclosure and select **View > Overview**. You can view information about the enclosure and its components in a front or rear graphical view, or in a front or rear tabular view.

- Front Graphical. Shows components at the front of the enclosure.
- Front Tabular. Shows information about:
  - The enclosure
  - Each disk



**NOTE:** SMU does not identify whether a disk is an SSD. To do so, select a disk and view its model number.

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- Rear Graphical. Shows components at the rear of the enclosure.
- Rear Tabular. Shows information about:
  - The enclosure
  - Each controller module, network port, host port, expansion port, CompactFlash card, and power supply
  - (Non-MSA70 drive enclosure) Each expansion I/O module, In port, and Out port
  - (MSA70 drive enclosure) Each expansion I/O module, power supply, and fan

In any of these views, select a component to see more information about it.



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## A SNMP reference

This appendix describes the Simple Network Management Protocol (SNMP) capabilities that 2000 G2 Modular Smart Array storage systems support. This includes standard MIB-II, the FibreAlliance SNMP Management Information Base (MIB) version 2.2 objects, and enterprise traps.

2000 G2 Modular Smart Array storage systems can report their status through SNMP. SNMP provides basic discovery using MIB-II, more detailed status with the FA MIB 2.2, and asynchronous notification using enterprise traps.

SNMP is a widely used network monitoring and control protocol. It is an application layer protocol that facilitates the exchange of management information between network devices. It is part of the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite.

SNMP enables network administrators to manage network performance, find and solve network problems, and plan for network growth. Data is passed from SNMP agents reporting activity on each network device to the workstation console used to oversee the network. The agents return information contained in a Management Information Base (MIB), which is a data structure that defines what is obtainable from the device and what can be controlled (turned on and off, etc.).

An SNMP object identifier (OID) is a number assigned to devices in a network for identification purposes. OID numbering is hierarchical. Using the IETF notation of digits and dots resembling very long IP addresses, various registries such as ANSII assign high-level numbers to vendors and organizations. They, in turn, append digits to the number to identify individual devices or software processes.

2000 G2 Modular Smart Array systems use SNMPv2c, which improves on SNMPv1 features and uses its community-based security scheme.

### Standard MIB-II behavior

MIB-II is implemented to support basic discovery and status.

In the system group, all objects can be read. The contact, name, and location objects can be set.

The system object identifier (`sysObjectID`) is based on the vendor name followed by ".2." and the identifier for the particular product model. For example, the object identifier for 2000 G2 Modular Smart Array storage systems is 1.3.6.1.4.1.11.2.51, where 51 is assigned for hpMSA. System uptime is an offset from the first time this object is read.

In the interfaces group, an internal PPP interface is documented, but it is not reachable from external to the device.

The address translation (at) and external gateway protocol (egp) groups are not supported.

### Enterprise traps

Traps can be generated in response to events occurring in the storage system. These events can be selected by severity and by individual event type. A maximum of three SNMP trap destinations can be configured by IP address.

Enterprise event severities are informational, minor, major, and critical. There is a different trap type for each of these severities. The trap format is represented by the HP enterprise traps MIB, `msa2000traps.mib`. Information included is the event ID, the event code type, and a text description generated from the internal event. Equivalent information can also be sent using email or popup alerts to users who are logged in to SMU.

The text of the trap MIB is included at the end of this appendix.

## FA MIB 2.2 SNMP behavior

The FA MIB 2.2 objects are in compliance with the FibreAlliance MIB v2.2 Specification (FA MIB2.2 Spec). For a full description of this MIB, go to: <http://www.emc.com/microsites/fibrealliance>.

FA MIB 2.2 is a subset of FA MIB 4.0, which is included with HP System Insight Manager (SIM) and other products. The differences are described in [FA MIB 2.2 and 4.0 Differences](#) on page 87.

FA MIB 2.2 was never formally adopted as a standard, but it is widely implemented and contains many elements useful for storage products. This MIB generally does not reference and integrate with other standard SNMP information; it is implemented under the experimental subtree.

Significant status within the device includes such elements as its temperature and power sensors, the health of its storage elements such as virtual disks, and the failure of any redundant component including an I/O controller. While sensors can be individually queried, for the benefit of network management systems all the above elements are combined into an “overall status” sensor. This is available as the unit status (`connUnitStatus` for the only unit), and a “sensor” in the sensor table.

The revisions of the various components within the device can be requested through SNMP.

The port section is only relevant to products with Fibre Channel host ports.

The event table allows 400 recently-generated events to be requested. Informational, minor, major, or critical event types can be selected; whichever type is selected enables the capture of that type and more severe events. This mechanism is independent of the assignment of events to be generated into traps.

The traps section is not supported. It has been replaced by an ability to configure trap destinations using the CLI or SMU. The statistics section is not implemented.

The following table lists the MIB objects, their descriptions and the value set in an 2000 G2 Modular Smart Array storage system. Unless specified otherwise, objects are *not* settable.

**Table 10** FA MIB 2.2 objects, descriptions, and values

Object	Description	Value
RevisionNumber	Revision number for this MIB	0220
UNumber	Number of connectivity units present	1
SystemURL	Top-level URL of the device; for example, <code>http://10.1.2.3</code> . If a web server is not present on the device, this string is empty in accordance with the FA MIB2.2 Spec.	Default: <code>http://10.0.0.1</code>
StatusChangeTime	<code>sysuptime</code> timestamp of the last status change event, in centiseconds. <code>sysuptime</code> starts at 0 when the Storage Controller boots and keeps track of the up time. <code>statusChangeTime</code> is updated each time an event occurs.	0 at startup
ConfigurationChangeTime	<code>sysuptime</code> timestamp of the last configuration change event, in centiseconds. <code>sysuptime</code> starts at 0 when the Storage Controller boots and keeps track of the up time. <code>configurationChangeTime</code> is updated each time an event occurs.	0 at startup
ConnUnitTableChangeTime	<code>sysuptime</code> timestamp of the last update to the <code>connUnitTable</code> (an entry was either added or deleted), in centiseconds	0 always (entries are not added to or deleted from the <code>connUnitTable</code> )

**Table 10** FA MIB 2.2 objects, descriptions, and values (continued)

Object	Description	Value
<b>connUnitTable</b>	<b>Includes the following objects as specified by the FA MIB2.2 Spec</b>	
connUnitId	Unique identification for this connectivity unit	Total of 16 bytes comprised of 8 bytes of the node WWN or similar serial number-based identifier (for example, 1000005013b05211) with the trailing 8 bytes equal to zero
connUnitGlobalId	Same as connUnitId	Same as connUnitId
connUnitType	Type of connectivity unit	storage-subsystem[11]
connUnitNumports	Number of host ports in the connectivity unit	Number of host ports
connUnitState	Overall state of the connectivity unit	online[2] or unknown[1], as appropriate
connUnitStatus	Overall status of the connectivity unit	ok [3], warning[4], failed[5], or unknown[1], as appropriate
connUnitProduct	Connectivity unit vendor's product model name	Model string
connUnitSn	Serial number for this connectivity unit	Serial number string
connUnitUpTime	Number of centiseconds since the last unit initialization	0 at startup
connUnitUrl	Same as systemURL	Same as systemURL
connUnitDomainId	Not used; set to all 1s as specified by the FA MIB2.2 Spec	0xFFFF
connUnitProxyMaster	Stand-alone unit returns yes for this object	yes [3] since this is a stand-alone unit
connUnitPrincipal	Whether this connectivity unit is the principal unit within the group of fabric elements. If this value is not applicable, returns unknown.	unknown[1]
connUnitNumSensors	Number of sensors in the connUnitSensorTable	33
connUnitStatusChangeTime	Same as statusChangeTime	Same as statusChangeTime
connUnitConfigurationChangeTime	Same as configurationChangeTime	Same as configurationChangeTime
connUnitNumRevs	Number of revisions in the connUnitRevsTable	16
connUnitNumZones	Not supported	0
connUnitModuleId	Not supported	16 bytes of 0s
connUnitName	Settable: Display string containing a name for this connectivity unit	Default: Uninitialized Name
connUnitInfo	Settable: Display string containing information about this connectivity unit	Default: Uninitialized Info
connUnitControl	Not supported	invalid[2] for an SNMP GET operation and not settable through an SNMP SET operation.

**Table 10** FA MIB 2.2 objects, descriptions, and values (continued)

Object	Description	Value
connUnitContact	Settable: Contact information for this connectivity unit	Default: Uninitialized Contact
connUnitLocation	Settable: Location information for this connectivity unit	Default: Uninitialized Location
connUnitEventFilter	Defines the event severity that will be logged by this connectivity unit. Settable only through SMU.	Default: info[8]
connUnitNumEvents	Number of events currently in the connUnitEventTable	Varies as the size of the Event Table varies
connUnitMaxEvents	Maximum number of events that can be defined in the connUnitEventTable	400
connUnitEventCurrID	Not supported	0
<b>connUnitRevsTable</b>	<b>Includes the following objects as specified by the FA MIB2.2 Spec</b>	
connUnitRevsUnitId	connUnitId of the connectivity unit that contains this revision table	Same as connUnitId
connUnitRevsIndex	Unique value for each connUnitRevsEntry between 1 and connUnitNumRevs	See <a href="#">External details for connUnitRevsTable on page 83</a>
connUnitRevsRevId	Vendor-specific string identifying a revision of a component of the connUnit	String specifying the code version. Reports "Not Installed or Offline" if module information is not available.
connUnitRevsDescription	Description of a component to which the revision corresponds	See <a href="#">External details for connUnitRevsTable on page 83</a>
<b>connUnitSensorTable</b>	<b>Includes the following objects as specified by the FA MIB2.2 Spec</b>	
connUnitSensorUnitId	connUnitId of the connectivity unit that contains this sensor table	Same as connUnitId
connUnitSensorIndex	Unique value for each connUnitSensorEntry between 1 and connUnitNumSensors	See <a href="#">External details for connUnitSensorTable on page 84</a>
connUnitSensorName	Textual identification of the sensor intended primarily for operator use	See <a href="#">External details for connUnitSensorTable on page 84</a>
connUnitSensorStatus	Status indicated by the sensor	ok[3], warning[4], or failed[5] as appropriate for FRUs that are present, or other[2] if FRU is not present.
connUnitSensorInfo	Not supported	Empty string
connUnitSensorMessage	Description the sensor status as a message	connUnitSensorName followed by the appropriate sensor reading. Temperatures display in both Celsius and Fahrenheit; for example, CPU Temperature (Controller Module A): 48C 118F). Reports "Not installed" or "Offline" if data is not available.
connUnitSensorType	Type of component being monitored by this sensor	See <a href="#">External details for connUnitSensorTable on page 84</a>
connUnitSensorCharacteristic	Characteristics being monitored by this sensor	See <a href="#">External details for connUnitSensorTable on page 84</a>



**Table 10** FA MIB 2.2 objects, descriptions, and values (continued)

Object	Description	Value
<b>connUnitPortTable</b>	<b>Includes the following objects as specified by the FA MIB2.2 Spec</b>	
connUnitPortUnitId	connUnitId of the connectivity unit that contains this port	Same as connUnitId
connUnitPortIndex	Unique value for each connUnitPortEntry between 1 and connUnitNumPorts	Unique value for each port, between 1 and the number of ports
connUnitPortType	Port type	not-present[3], or n-port[5] for point-to-point topology, or l-port[6]
connUnitPortFCClassCap	Bit mask that specifies the classes of service capability of this port. If this is not applicable, returns all bits set to zero.	Fibre Channel ports return 8 for class-three
connUnitPortFCClassOp	Bit mask that specifies the classes of service that are currently operational. If this is not applicable, returns all bits set to zero.	Fibre Channel ports return 8 for class-three
connUnitPortState	State of the port hardware	unknown[1], online[2], offline[3], bypassed[4]
connUnitPortStatus	Overall protocol status for the port	unknown[1], unused[2], ok[3], warning[4], failure[5], notparticipating[6], initializing[7], bypass[8]
connUnitPortTransmitterType	Technology of the port transceiver	unknown[1] for Fibre Channel ports
connUnitPortModuleType	Module type of the port connector	unknown[1]
connUnitPortWwn	Fibre Channel World Wide Name (WWN) of the port if applicable	WWN octet for the port, or empty string if the port is not present
connUnitPortFCId	Assigned Fibre Channel ID of this port	<ul style="list-style-type: none"> <li>Fibre Channel ID of the port</li> <li>All bits set to 1 if the Fibre Channel ID is not assigned or if the port is not present</li> </ul>
connUnitPortSn	Serial number of the unit (for example, for a GBIC). If this is not applicable, returns an empty string.	Empty string
connUnitPortRevision	Port revision (for example, for a GBIC)	Empty string
connUnitPortVendor	Port vendor (for example, for a GBIC)	Empty string
connUnitPortSpeed	Speed of the port in KByte per second (1 KByte = 1000 Byte)	Port speed in KByte per second, or 0 if the port is not present
connUnitPortControl	Not supported	invalid[2] for an SNMP GET operation and not settable through an SNMP SET operation
connUnitPortName	String describing the addressed port	See <a href="#">External details for connUnitPortTable on page 85</a>
connUnitPortPhysicalNumber	Port number represented on the hardware	Port number represented on the hardware
connUnitPortStatObject	Not supported	0 (No statistics available)

**Table 10** FA MIB 2.2 objects, descriptions, and values (continued)

Object	Description	Value
<b>connUnitEventTable</b>	<b>Includes the following objects as specified by the FA MIB2.2 Spec</b>	
connUnitEventUnitId	connUnitId of the connectivity unit that contains this port	Same as connUnitId
connUnitEventIndex	Index into the connectivity unit's event buffer, incremented for each event	Starts at 1 every time there is a table reset or the unit's event table reaches its maximum index value
connUnitEventId	Internal event ID, incremented for each event, ranging between 0 and connUnitMaxEvents	Starts at 0 every time there is a table reset or connUnitMaxEvents is reached
connUnitREventTime	Real time when the event occurred, in the following format: <i>DDMMYYYY HHMMSS</i>	0 for logged events that occurred prior to or at startup
connUnitSEventTime	sysuptime timestamp when the event occurred	0 at startup
connUnitEventSeverity	Event severity level	error[5], warning[6] or info[8]
connUnitEventType	Type of this event	As defined in CAPI
connUnitEventObject	Not used	0
connUnitEventDescr	Text description of this event	Formatted event, including relevant parameters or values
connUnitLinkTable	Not supported	N/A
connUnitPortStatFabricTable	Not supported	N/A
connUnitPortStatSCSITable	Not supported	N/A
connUnitPortStatLANTable	Not supported	N/A
<b>SNMP TRAPS</b>	<b>The following SNMP traps are supported</b>	
trapMaxClients	Maximum number of trap clients	1
trapClientCount	Number of trap clients currently enabled	1 if traps enabled; 0 if traps not enabled
connUnitEventTrap	This trap is generated each time an event occurs that passes the connUnitEventFilter and the trapRegFilter	N/A
trapRegTable	Includes the following objects per the FA MIB2.2 Spec	
trapRegIpAddress	IP address of a client registered for traps	IP address set through Telnet
trapRegPort	User Datagram Protocol (UDP) port to send traps to for this host	162
trapRegFilter	Settable: Defines the trap severity filter for this trap host. The connUnit will send traps to this host that have a severity level less than or equal to this value.	Default: warning[6]

**Table 10** FA MIB 2.2 objects, descriptions, and values (continued)

Object	Description	Value
trapRegRowState	Specifies the state of the row	<ul style="list-style-type: none"> <li>• READ: rowActive[3] if traps are enabled through Telnet; otherwise rowInactive[2]</li> <li>• WRITE: Not supported</li> </ul>

## External details for certain FA MIB 2.2 objects

Tables in this section specify values for certain objects described in [Table 10](#).

### External details for connUnitRevsTable

**Table 11** connUnitRevsTable index and description values

connUnitRevsIndex	connUnitRevsDescription
1	Firmware revision for Storage Controller (Controller A)
2	Firmware revision for Storage Controller (Controller B)
3	Firmware revision for Memory Controller (Controller A)
4	Firmware revision for Memory Controller (Controller B)
5	Firmware revision for Storage Controller loader (Controller A)
6	Firmware revision for Storage Controller loader (Controller B)
7	Firmware revision for Management Controller (Controller A)
8	Firmware revision for Management Controller (Controller B)
9	Firmware revision for MC loader (Controller A)
10	Firmware revision for MC loader (Controller B)
11	Firmware Revision for Unified CPLD (Controller A)
12	Firmware Revision for Unified CPLD (Controller B)
13	Firmware Revision for Expander (Controller A)
14	Firmware Revision for Expander (Controller B)
15	Hardware Revision for Controller A
16	Hardware Revision for Controller B

## External details for connUnitSensorTable

**Table 12** connUnitSensorTable index, name, type, and characteristic values

connUnitSensorIndex	connUnitSensorName	connUnitSensorType	connUnitSensorCharacteristic
1	CPU Temperature (Controller A)	board [8]	temperature[3]
2	CPU Temperature (Controller B)	board [8]	temperature[3]
3	FPGA Temperature (Controller A)	board [8]	temperature[3]
4	FPGA Temperature (Controller B)	board [8]	temperature[3]
5	Onboard Temperature 1 (Controller A)	board [8]	temperature[3]
6	Onboard Temperature 1 (Controller B)	board [8]	temperature[3]
7	Onboard Temperature 2 (Controller 1)	board [8]	temperature[3]
8	Onboard Temperature 2 (Controller 2)	board [8]	temperature[3]
9	Capacitor Temperature (Controller 3)	board [8]	temperature[3]
10	Capacitor Temperature (Controller 4)	board [8]	temperature[3]
11	CM Temperature (Controller A)	enclosure[7]	temperature[3]
12	CM Temperature (Controller A)	enclosure[7]	temperature[3]
13	Power Supply 1 Temperature	enclosure[7]	temperature[3]
14	Power Supply 2 Temperature	enclosure[7]	temperature[3]
15	Capacitor Pack Voltage (Controller A)	board [8]	power[9]
16	Capacitor Pack Voltage (Controller B)	board [8]	power[9]
17	Capacitor Cell 1 Voltage (Controller A)	board [8]	power[9]
18	Capacitor Cell 1 Voltage (Controller B)	board [8]	power[9]
19	Capacitor Cell 2 Voltage (Controller A)	board [8]	power[9]
20	Capacitor Cell 2 Voltage (Controller B)	board [8]	power[9]
21	Capacitor Cell 3 Voltage (Controller A)	board [8]	power[9]
22	Capacitor Cell 3 Voltage (Controller B)	board [8]	power[9]
23	Capacitor Cell 4 Voltage (Controller A)	board [8]	power[9]
24	Capacitor Cell 4 Voltage (Controller B)	board [8]	power[9]
25	Capacitor Charge Current (Controller A)	board [8]	currentValue[6]
26	Capacitor Charge Current (Controller B)	board [8]	currentValue[6]
27	Power Supply 1 Voltage, 12V	power-supply[5]	power[9]
28	Power Supply 1 Voltage, 5V	power-supply[5]	power[9]
29	Power Supply 1 Voltage, 3.3V	power-supply[5]	power[9]
30	Power Supply 2 Voltage, 12V	power-supply[5]	power[9]
31	Power Supply 2 Voltage, 5V	power-supply[5]	power[9]
32	Power Supply 2 Voltage, 3.3V	power-supply[5]	power[9]
33	Overall Status	enclosure[7]	other[2]

## External details for connUnitPortTable

**Table 13** connUnitPortTable index and name values

connUnitPortIndex	connUnitPortName
1	Host Port 1 (Controller A)
2	Host Port 2 (Controller B)
3	Host Port 1 (Controller A)
4	Host Port 2 (Controller B)

## Configuring SNMP event notification in SMU

1. Verify that the storage system's SNMP service is enabled; see [Changing management interface settings](#) on page 33.
2. Configure and enable SNMP traps; see [Configuring SNMP notification](#) on page 34.

## SNMP management

You can manage storage devices using SNMP with a network management system such as HP System Insight Manager (SIM), or HP Instant Support Enterprise Edition (ISEE). See their documentation for information about loading MIBs, configuring events, and viewing and setting group objects.

In order to view and set system group objects, SNMP must be enabled in the storage system; see [Step 4: Enabling system-management services](#) on page 29.

## Enterprise trap MIB

The following pages show the source for the HP enterprise traps MIB, `msa2000traps.mib`. This MIB defines the content of the SNMP traps that 2000 G2 Modular Smart Array storage systems generate.

```
-----
-- MSA2000 Array MIB for SNMP Traps
--
-- $Revision: 11692 $
--
-- Copyright (c) 2008 Hewlett-Packard Development Company, L.P.
-- Copyright (c) 2005-2008 Dot Hill Systems Corp.
-- Confidential computer software. Valid license from HP required for possession,
-- use or copying. Consistent with FAR 12.211 and 12.212, Commercial Computer
-- Software, Computer Software Documentation, and Technical Data for Commercial
-- Items are licensed to the U.S. Government under vendor's standard commercial
-- license.
--
-- MSA2000traps MIB Revision
-- =====
-- Revision 1.1 2008/02/27
-- Initial revision
-- Revision 1.2 2008/03/18
-- Updated copyright notice
--
-----

MSA2000TRAPS-MIB
-- Last edit date: Feb 27th, 2008
DEFINITIONS ::= BEGIN
    IMPORTS
        enterprises
            FROM RFC1155-SMI
        TRAP-TYPE
```

```

FROM RFC-1215
connUnitEventId, connUnitEventType, connUnitEventDescr
FROM FA-MIB40;

--Textual conventions for this MIB
-----

-- vendor
hp      OBJECT IDENTIFIER ::= { enterprises 11 }
nm      OBJECT IDENTIFIER ::= { hp 2 }
hpMSA   OBJECT IDENTIFIER ::= { nm 51 }

-- Related traps

msaEventInfoTrap TRAP-TYPE
    ENTERPRISE hpMSA
    VARIABLES { connUnitEventId,
                connUnitEventType,
                connUnitEventDescr }
    DESCRIPTION
        "An event has been generated by the storage array.
        Recommended severity level (for filtering): info"

    -- Trap annotations are as follows:
    --#TYPE "Informational storage event"
    --#SUMMARY "Informational storage event # %d, type %d, description: %s"
    --#ARGUMENTS {0,1,2}
    --#SEVERITY INFORMATIONAL
    --#TIMEINDEX 6
    ::= 3001

msaEventWarningTrap TRAP-TYPE
    ENTERPRISE hpMSA
    VARIABLES { connUnitEventId,
                connUnitEventType,
                connUnitEventDescr }
    DESCRIPTION
        "An event has been generated by the storage array.
        Recommended severity level (for filtering): warning"

    -- Trap annotations are as follows:
    --#TYPE "Warning storage event"
    --#SUMMARY "Warning storage event # %d, type %d, description: %s"
    --#ARGUMENTS {0,1,2}
    --#SEVERITY MINOR
    --#TIMEINDEX 6
    ::= 3002

msaEventErrorTrap TRAP-TYPE
    ENTERPRISE hpMSA
    VARIABLES { connUnitEventId,
                connUnitEventType,
                connUnitEventDescr }
    DESCRIPTION
        "An event has been generated by the storage array.
        Recommended severity level (for filtering): error"

```

```

-- Trap annotations are as follows:
--#TYPE "Error storage event"
--#SUMMARY "Error storage event # %d, type %d, description: %s"
--#ARGUMENTS {0,1,2}
--#SEVERITY MAJOR
--#TIMEINDEX 6
::= 3003

msaEventCriticalTrap TRAP-TYPE
    ENTERPRISE hpMSA
    VARIABLES { connUnitEventId,
                connUnitEventType,
                connUnitEventDescr }
    DESCRIPTION
        "An event has been generated by the storage array.
        Recommended severity level (for filtering): critical"

-- Trap annotations are as follows:
--#TYPE "Critical storage event"
--#SUMMARY "Critical storage event # %d, type %d, description: %s"
--#ARGUMENTS {0,1,2}
--#SEVERITY CRITICAL
--#TIMEINDEX 6
::= 3004

END

```

## FA MIB 2.2 and 4.0 Differences

FA MIB 2.2 is a subset of FA MIB 4.0. Therefore, SNMP elements implemented in 2000 G2 Modular Smart Array storage systems can be accessed by a management application that uses FA MIB 4.0.

The following tables are *not* implemented in 2.2:

- connUnitServiceScalars
- connUnitServiceTables
- connUnitZoneTable
- connUnitZoningAliasTable
- connUnitSnsTable
- connUnitPlatformTable

The following variables are *not* implemented in 2.2:

- connUnitFabricID
- connUnitNumLinks
- connUnitVendorId
- connUnitPortProtocolCap,  
connUnitPortProtocolOp,  
connUnitPortNodeWwn,  
connUnitPortHWState
- connUnitLinkCurrIndex





## B Event code reference

Information in this appendix is for reference by storage administrators and technical support personnel to aid troubleshooting.

An *event code* identifies a type of event that has occurred in the storage system, and corresponds to an event message that is recorded in the system's event log, which you can view using SMU or the CLI. You may also receive notifications, depending on your SMU event notification settings.

An event may result from one or more errors, each of which has an *error code*. Error codes provide more information to technical support personnel about the problem that occurred on the system. (Error codes are not described in this guide.)

The following table describes the events that can occur during operation. Events are listed in order by numeric event code. Recommended actions available at this time are also listed.

**Table 14** Event code descriptions and recommended actions

Event code	Event type	Description	Recommended action
1	Warning	A disk in the specified vdisk failed. The vdisk is online but not fault tolerant. If a spare is present the controller automatically uses the spare to reconstruct the vdisk.	<ul style="list-style-type: none"> <li>• See <a href="#">Table 15</a>.</li> <li>• If dynamic spares is enabled, replace the failed disk. The system automatically reconstructs the vdisk.</li> <li>• If dynamic spares is disabled and no spare is available, replace the failed disk and add it as a vdisk spare to the critical vdisk.</li> </ul>
3	Critical	The specified vdisk is now offline. If a spare is present the controller automatically uses the spare to reconstruct the vdisk.	If no spare is available, replace the failed disk and add it as a vdisk spare to the critical vdisk.
4	Informational	A disk had an uncorrectable error and the controller reassigned the block.	
6	Informational or warning	Vdisk creation status. This event is logged as informational if creation immediately failed, was canceled by the user, or succeeded. This event is logged as a warning if creation failed during initialization.	
8	Warning	A disk in a vdisk failed and the vdisk changed to a critical or offline state. If a spare is present the controller automatically uses the spare to reconstruct the vdisk.	<ul style="list-style-type: none"> <li>• See <a href="#">Table 15</a>.</li> <li>• If dynamic spares is enabled, replace the failed disk. The system automatically reconstructs the vdisk.</li> <li>• If dynamic spares is disabled and no spare is available, replace the failed disk and add it as a vdisk spare to the critical vdisk.</li> </ul>
9	Informational	A spare disk has been used in a critical vdisk to bring the vdisk back to a fault-tolerant state. Vdisk reconstruction starts automatically.	
16	Informational	A global spare has been added.	
18	Informational or warning	Vdisk reconstruction status. This event is logged as informational if reconstruction succeeded, or as a warning if reconstruction failed.	

**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
19	Informational	A rescan has completed.	
20	Informational	A firmware update has completed.	
21	Informational or warning	Vdisk verification has completed. This event is logged as informational if the command fails immediately, succeeds, or is aborted by the user; or a warning if the operation fails during verification.	
23	Informational	Vdisk creation has started.	
24	Informational	The assigned LUN for this volume has changed.	
25	Informational	The statistics for the specified vdisk have been reset.	
27	Informational	Cache parameters have been changed for the specified vdisk.	
28	Informational	Controller parameters have been changed. This event is logged when general configuration changes are made; for example, utility priority, remote notification settings, user interface passwords, and management port IP values. This event is <i>not</i> logged when changes are made to vdisk or volume configuration.	
31	Informational	A global or vdisk spare was deleted.	
32	Informational	Vdisk verification has started.	
33	Informational	Controller time/date has been changed. This event is logged before the change happens so the event timestamp shows the "old" time.	
34	Informational	Controller has been restored to factory defaults.	For an FC controller, restart it to make the default loop ID take effect.
37	Informational	Vdisk reconstruction has started.	
39	Warning	The sensors monitored a temperature or voltage in the warning range.	<ul style="list-style-type: none"> <li>• Check that the storage system's fans are running.</li> <li>• Check that the ambient temperature is not too warm. The enclosure operating range is 41–104° F (5–40° C).</li> <li>• Check for any obstructions to the airflow.</li> <li>• If none of the above explanations apply, replace the controller FRU that reported the error.</li> </ul> <p>When the problem is fixed, event 47 is logged.</p>

**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
40	Critical	The sensors monitored a temperature or voltage in the failure range.	<ul style="list-style-type: none"> <li>• Check that the storage system's fans are running.</li> <li>• Check that the ambient temperature is not too warm. The enclosure operating range is 41–104° F (5–40° C).</li> <li>• Check for any obstructions to the airflow.</li> <li>• If none of the above explanations apply, replace the controller FRU that reported the error.</li> </ul> <p>When the problem is fixed, event 47 is logged.</p>
41	Informational	A vdisk spare has been added.	
43	Informational	A vdisk has been deleted.	
44	Warning	The controller contains dirty cache data for the specified volume but the corresponding disks are not online.	<ul style="list-style-type: none"> <li>• Determine the reason that the disks are not online.</li> <li>• If an enclosure is down, determine corrective action.</li> <li>• If the vdisk is no longer needed, you can clear the orphan data; this will result in lost data.</li> </ul>
45	Informational	A communication failure has occurred between the controller and an EMP.	
47	Informational	An error detected by the sensors has been cleared.	
48	Informational	The vdisk name has been changed.	
49	Informational	A lengthy SCSI maintenance command has completed. Output indicates whether it completed successfully or a failure occurred.	
52	Informational	Vdisk expansion has started.	This operation can take days to complete.
53	Informational or warning	This event is logged as informational when a vdisk expansion has completed or a RAID morph operation is canceled by the user. This event is logged as a warning if the RAID morph operation fails.	
55	Informational	A SMART event occurred on the specified disk.	Impending disk failure. See <a href="#">Table 15</a> .
56	Informational	The SC has been restarted.	
58	Warning or informational	A disk or other SCSI device (such as an EMP) detected an error. This event is logged as a warning for serious errors such as parity or disk hardware failure, and as informational for other errors.	<ul style="list-style-type: none"> <li>• For warning events that indicate a disk is bad, replace that disk.</li> <li>• For warning events that indicate an expansion module is bad, replace that expansion module.</li> </ul>

**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
59	Warning or informational	The controller detected an error while communicating with the specified SCSI device. The error was detected by the controller, not the disk. This event is logged as a warning for parity errors, and as informational for other errors.	<ul style="list-style-type: none"> <li>For warning events that indicate a disk is bad, replace that disk.</li> <li>For warning events that indicate an expansion module is bad, replace that expansion module.</li> </ul>
60	Informational	A disk channel was reset from another initiator or target.	
61	Critical	A serious error, which might indicate hardware failure, occurred while communicating on the specified disk channel. The controller will attempt to recover.	<ul style="list-style-type: none"> <li>If the controller recovers, no action is required.</li> <li>View other logged events to determine other action to take.</li> </ul>
62	Informational	A spare disk has failed.	Replace the failed disk.
65	Critical	An uncorrectable ECC error occurred on the buffer memory on startup. The controller is automatically restarted and—if it was operating in active-active mode (i.e., independent cache performance mode was disabled)—its cache data is restored from the partner controller's cache.	
67	Informational	The controller has identified a new disk or group of disks that constitute a vdisk and has taken ownership of the vdisk. This can happen when disks containing data have been inserted from another enclosure. This event only applies to non-Active-Active controllers.	
68	Informational	Controller is in a shut-down state.	
69	Critical	Enclosure reported a general failure.	Check the controller module or expansion module for problems such as not being fully inserted, and for bad cables.
71	Informational	The controller has started or completed failing over.	
72	Informational	(Active-active environment) After failover, recovery has started or has completed.	
73	Informational	(Active-active environment) The two controllers are communicating with each other and cache redundancy is enabled.	
74	Informational	The FC loop ID for the specified vdisk was changed to be consistent with the IDs of other vdisks. This can occur when disks containing a vdisk are inserted from an enclosure having a different FC loop ID.  This event is also logged by the new owning controller after vdisk ownership is changed.	

**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
75	Informational	The specified volume's LUN has been unassigned because it conflicts with LUNs assigned to other volumes. This can happen when disks containing data for a mapped volume have been inserted from another enclosure.	If you want hosts to access the volume data on the inserted disks, map the volume with a different LUN.
76	Informational	The controller is using default configuration settings. This event occurs on the first power up, and might occur after a firmware update.	If you have just performed a firmware update and your system requires special configuration settings, you must make those configuration changes before your system will operate as before.
77	Informational	The cache was initialized as a result of power up or failover.	
78	Warning	The controller could not use an assigned spare for a vdisk because the spare's capacity is too small. This occurs when a vdisk's status becomes critical and all global spares are too small or (if dynamic spares are enabled) all disks are too small.	Replace existing spares or add spares with enough capacity to replace the smallest disk in the vdisk. The vdisk size is limited by its disk with the least capacity.
79	Informational	The trust vdisk operation has completed successfully.	
80	Informational	The controller has modified mode parameters on one or more disks.	
81	Informational	The current controller has unkilld the partner controller. The other controller will restart.	
83	Informational	The partner controller is changing state (shutting down or restarting).	
84	Warning	In an active-active configuration, the current controller has forced the partner controller to fail over for the specified reason.	Save the log files and contact a service technician.
86	Informational	The FC host port or disk parameters have been changed.	
87	Warning	The mirrored configuration retrieved by this controller from the partner controller has bad cyclic redundancy check (CRC). The local flash configuration will be used instead.	The mirrored configuration is corrupted. Configuration data on the two controllers may be out of sync. Clear configuration may be needed to fully recover from this.
88	Warning	The mirrored configuration retrieved by this controller from the partner controller is corrupt. The local flash configuration will be used instead.	The mirrored configuration is corrupted. Configuration data on the two controllers may be out of sync. Clear configuration may be needed to fully recover from this.
89	Warning	The mirrored configuration retrieved by this controller from the partner controller has a configuration level that is too high for the firmware in this controller to process. The local flash configuration will be used instead.	This likely indicates that the current controller has down-level firmware. Update the firmware on the down-level controller. Both controllers should have the same firmware versions.  When the problem is fixed, event 20 is logged.

**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
90	Informational	The partner controller does not have a mirrored configuration image for the current controller, so the current controller's local flash configuration is being used. This event is expected if the other controller is new or its configuration has been cleared.	
95	Critical	Both controllers in an active-active configuration have the same serial number. Non-unique serial numbers can cause system problems; for example, vdisk ownership and WWNs are determined by serial number.	A service technician must examine both controller serial numbers and change at least one of them.
96	Informational	Pending configuration changes that take effect at startup were ignored because customer data might be present in cache.	If the requested configuration changes did not occur, make the changes again and then use a user-interface command to shut down or restart the controller.
100	Informational	During active-active operation, an event (potential error) occurred while communicating with the EMP, which reports SES data.	
101	Informational	An update of EMP data has been triggered. This event is for internal use only.	
103	Informational	Volume name change is complete.	
104	Informational	Volume size change is complete.	
105	Informational	Volume LUN change is complete.	
106	Informational	A volume has been added.	
107	Critical	The controller experienced the specified critical error. In a non-redundant configuration the controller will be restarted automatically. In an active-active configuration the surviving controller will kill the controller that experienced the critical error.	A service technician can use the debug log to determine the problem.
108	Informational	A volume has been deleted.	
109	Informational	The statistics for the specified vdisk have been reset.	
110	Informational	Ownership of the specified vdisk has been given to the other controller.	
111	Informational	The link for the specified host port is up.	
112	Informational or warning	The link for the specified host port is down. This event is logged as informational for expected link-down events that happen during controller startup. This event is logged as a warning for unexpected link-down events.	
113	Informational	The link for the specified disk channel port is up.	
114	Informational	The link for the specified disk channel port is down.	

**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
116	Critical	After a recovery, the partner controller was killed while mirroring write-back data to the current controller. The current controller restarted to avoid losing the data in the partner controller's cache, but if the other controller does not restart successfully, the data will be lost.	To determine if data might have been lost, check whether this event was immediately followed by restart event 56, closely followed by failover event 71 (specifying p1=1).
118	Informational	Cache parameters have been changed for the specified vdisk.	
127	Warning	The controller has detected an invalid disk dual-port connection. This connection does not have the benefit of fault tolerance. Failure of the disk port would cause loss of access to the disk.	The single disk port should be connected to one controller only.
136	Warning	Errors detected on the specified disk channel have caused the storage system to mark the channel as degraded.	Determine the source of the errors on the specified disk channel and replace the faulty hardware.  When the problem is fixed, event 189 is logged.
139	Informational	The MC has powered up or restarted.	
140	Informational	The MC is about to restart.	
141	Informational	The IP address has been changed in the MC.	
152	Informational or warning	The MC has not sent a command to the SC for an interval that exceeds the MC communication timeout, and may have failed. This is sometimes referred to as a "LAN not talking" error. This event is logged as informational when the SC has not received communication from the MC for 160 seconds. If communication is restored in less than 15 minutes, event 153 is logged. If the SC has not received communication from the MC for 15 minutes, this event is logged as a warning, the SC restarts the MC, and event 156 is logged.	If this occurs repeatedly and user interfaces are not working normally, a hardware failure is indicated. Replace the controller module that is logging this event.
153	Informational	The MC has re-established communication with the SC.	
154	Informational	New software has been loaded on the MC.	
155	Informational	New loader software has been loaded on the MC.	
156	Informational	The MC has been restarted from the SC.	
157	Critical	A failure occurred when trying to write to the SC flash chip.	Replace the controller module.
158	Informational	A correctable ECC error occurred in the CPU memory.	
160	Warning	The EMP enclosures are not configured correctly. All enclosure EMPs on that channel are disabled.	Check that EMP enclosures are configured correctly and issue a rescan.

**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
161	Informational	One or more enclosures do not have a valid path to an EMP. All enclosure EMPs are disabled.	
162	Warning	<p>The host WWNs (node and port) previously presented by this controller module in this system are unknown. This event has two possible causes:</p> <ul style="list-style-type: none"> <li>• One or both controller modules have been replaced or moved while the system was powered off.</li> <li>• One or both controller modules have had their flash configuration cleared (this is where the previously used WWNs are stored).</li> </ul> <p>The controller module recovers from this situation by generating a WWN based on its own serial number.</p>	Verify the WWN information for this controller module on all hosts that access it.
163	Warning	<p>The host WWNs (node and port) previously presented by an offline controller module in this system are unknown.</p> <p>This event has two possible causes:</p> <ul style="list-style-type: none"> <li>• The online controller module reporting the event was replaced or moved while the system was powered off.</li> <li>• The online controller module had its flash configuration (where previously used WWNs are stored) cleared.</li> </ul> <p>The online controller module recovers from this situation by generating a WWN for the other controller module based on its own serial number.</p>	Verify the WWN information for the other controller module on all hosts that access it.
166	Warning	The RAID metadata level of the two controllers does not match. Usually, the controller at the higher firmware level can read metadata written by a controller at a lower firmware level. The reverse is typically not true. Therefore, if the controller at the higher firmware level failed, the surviving controller at the lower firmware level cannot read the metadata on disks that have failed over.	Update the controller with the lower firmware level to match the firmware level on the other controller.
167	Warning	A diagnostic test at controller bootup detected an abnormal operation, which might require a power cycle to correct.	A service technician must review the error information returned.
168	Critical, warning or informational	The specified SES alert condition was detected in the enclosure indicated. Critical severity is reported if one of the power supplies in an enclosure has no power supplied to it or if a hardware failure is detected.	Most voltage and temperature errors and warnings relate to the power supply module; see <a href="#">Table 16</a> . If this is logged as a critical event and there is no problem with the power source, the indicated FRU has probably failed and should be replaced.



**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
169	Informational	The specified SES alert condition has been cleared in the enclosure indicated.	This event is generated when the problem that caused event 168 is cleared.
170	Informational	The last rescan indicates that the specified enclosure was added to the system.	
171	Informational	The last rescan indicates that the specified enclosure was removed from the system.	
172	Warning	The specified vdisk has been quarantined because not all of its disks are available. There are not enough disks to be fault tolerant. The partial vdisk will be held in quarantine until it becomes fault tolerant.	<ul style="list-style-type: none"> <li>• Ensure that all disks are latched into their slots and have power.</li> <li>• During quarantine, the vdisk is not visible to the host. If after latching disks into their slot and powering up the vdisk, the vdisk is still quarantined, you can manually remove the vdisk from quarantine so that the host can see the vdisk. The vdisk is still critical.</li> </ul> <p>When the vdisk has been removed from quarantine, event 173 is logged.</p>
173	Informational	The specified vdisk has been removed from quarantine.	
174	Informational	A device firmware update has completed.	
175	Informational	An Ethernet link has changed status (up/down).	
176	Informational	The error statistics for the specified disk have been reset.	
177	Informational	The cache data for a missing volume was purged.	
181	Informational	Advanced Network Interface Structure was set. The MC configuration has been changed.	
182	Informational	All busses have been paused. I/O will not be performed on the disks until all busses are unpaused.	
183	Informational	All busses have been unpaused, meaning that I/O can resume. An unpauses initiates a rescan, which is also logged.	
185	Informational	An EMP write command has completed.	
186	Informational	Enclosure parameters have been set.	
187	Informational	The write-back cache has been enabled due to a battery state change.	
188	Informational	Write-back cache has been disabled due to a battery state change.	
189	Informational	A disk channel that was previously degraded or failed is now healthy.	

**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
190–201	Informational	Includes component-specific environmental indicator events generated by the auto-write-through feature when an environmental change occurs. If an auto-write-through-trigger condition has been met, write-back cache is disabled and event 188 is also logged. Once the fault is resolved, event 187 is logged to indicate that write-back mode has been restored.	
202	Informational	An auto-write-through-trigger condition has been cleared, causing write-back cache to be re-enabled. The environmental change is also logged. (See events 190–200 and 241 and 242.)	
203	Warning	An environmental change occurred that allows write-back cache to be enabled, but the auto-write-back preference is not set.  The environmental change is also logged. (See events 190–200.)	Manually enable write-back cache.
204	Warning or informational	This event is generated by the hardware flush firmware whenever the boot processing firmware needs to inform the user about something.	Send the log file to the service technician for further diagnosis.
205	Informational	The specified volume has been mapped or unmapped.	
206	Informational	Vdisk scrub has started.	
207	Informational, warning, or critical	Vdisk scrub has completed. The event message reports the number of: <ul style="list-style-type: none"> <li>• Data parity mismatches for RAID 3, 5, 6, and 50</li> <li>• Mirror verify errors for RAID 1 and 10</li> <li>• Medium errors for other RAID levels</li> </ul>	If data parity errors are reported, contact technical support. Data may be at risk.
210	Informational	All snapshot volumes have been deleted.	
211	Informational or Warning	The SAS topology has changed; components were added or removed. The message specifies the number of elements in the SAS map, the number of expanders detected, the number of expansion levels on the native (local controller) side and on the partner (partner controller) side, and the number of device PHYs. This event is logged as informational anytime the number of SAS expanders change. This event is logged as a warning if no elements are detected in the SAS map.	If the event is a warning, ensure that the SAS map is up and that all expected disks are detected. If the SAS map is not up or expected disks are not detected, perform a rescan. If a rescan does not resolve the problem, then shut down and restart both controllers.
212	Informational	All master volumes have been deleted.	
213	Informational	A standard volume has been converted to a master volume or a master volume has been converted to a standard volume.	

**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
214	Informational	The creation of snapshots is complete. The number of snapshots is specified.	
215	Informational	A previously created batch of snapshots is now committed and ready for use. The number of snapshots is specified.	
217	Critical	A super-capacitor failure has occurred on the controller.	A service technician must replace the super-capacitor pack on the controller reporting this event.
218	Warning	The super-capacitor pack is near end of life.	A service technician must replace the super-capacitor pack on the controller reporting this event.
219	Informational	Utility priority has changed.	
220	Informational	Master volume rollback operation has started.	
221	Informational	Snapshot reset is completed.	
222	Informational	Setting of the policy for the snap pool is complete. Policy is the action to be taken when the snap pool hits the threshold level.	
223	Informational	The threshold level for the snap pool has been set. Each snap pool has three policy levels that notify you when the snap pool is reaching decreasing capacity. Each policy level has an associated policy that specifies system behavior when the threshold is reached.	
224	Informational	A background master volume rollback operation has completed.	
225	Critical	Background master write copy-on-write operation has failed. There was an internal I/O error. Could not complete the write operation to the disk.	A probable hardware failure has prevented the software from operating successfully. Isolate and replace and failed hardware components. Once the hardware issues have been corrected, it might be necessary to delete all snapshots and restart the controller.
226	Critical	A background master volume rollback failed to start due to inability to initialize the snap pool. All rollback is in a suspended state.	Make sure the snap pool and the vdisk on which this volume exists are online. Restart the rollback operation.
227	Critical	Failure to execute rollback for a particular portion of the master volume.	Restart the rollback operation.
228	Critical	Background rollback for a master volume failed to end due to inability to initialize the snap pool. All rollback is in a suspended state.	Make sure the snap pool and the vdisk on which this volume exists are online. Restart the rollback operation.
229	Warning	The snap pool has reached the snap pool warning threshold.	The user can set up the policy for the snap pool.

**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
230	Warning	The snap pool has reached the snap pool error threshold.  The system will take the action set up in the policy. Default is to delete the oldest snapshot.	You can expand the snap pool or delete snapshots.
231	Critical	The snap pool has reached the snap pool critical threshold.  The system will take the action set up in the policy. Default is to delete all snapshots on the snap pool.	If the policy is to halt writes, then you must free up space on the snap pool master, or convert the master volume to a standard volume in order to resume operations.
232	Warning	The maximum number of enclosures allowed for the current configuration has been exceeded.	The platform does not support the number of enclosures that are configured. The firmware has removed the enclosure indicated by this event from its configuration.
233	Warning	The specified disk type is invalid and not allowed in the current configuration.	One or more disks are not allowed for this platform. They have been removed from the configuration. Replace the disallowed disks with ones that are supported.
234	Critical	The specified snap pool is unrecoverable and can therefore no longer be used.	All the snapshots associated with this snap pool are invalid and the user may want to delete them. However, the data on the master volume can be recovered by converting it to a standard volume.
235	Informational	A non-disk SCSI device, such as an EMP or partner controller, has reported a check condition.	
236	Informational	A special shutdown operation has started.	
237	Informational	A firmware update has started and is in progress.	
238	Warning	An attempt to write license data failed due to an invalid license.	Check the license for what is allowed for the platform, make corrections as appropriate, and reinstall. If the license is invalid, the write will fail.
239	Warning	A timeout has occurred while flushing the CompactFlash.	Cycle power and restart the system.  If the error persists, save the log files and contact a service technician.
240	Warning	A failure has occurred while flushing the CompactFlash.	Cycle power and restart the system.  If the error persists, save the log files and contact a service technician.
241–242	Informational	CompactFlash status events generated by the auto-write-through feature whenever an environmental change occurs. If an auto-write-through-trigger condition has been met, write-back cache is disabled.	
243	Informational	A new RAID enclosure has been detected. This happens when a controller FRU is moved from one enclosure to another and the enclosure detects that the midplane WWN is different from the WWN it has in its local flash.	

**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
245	Informational	An existing disk channel target device is not responding to SCSI discovery commands.	Check the indicated target device for bad hardware or bad cable, then initiate a rescan.
246	Warning	The coin battery is either not present, or it is not properly seated, or it has reached end of life. (The battery is a battery backup for the real-time (date/time) clock. In the event of a power failure, the date and time will revert to January 1, 1970 00:00:00.	The coin battery is on the controller module. A service technician must replace or reseal the battery.
247	Warning	The FRU-ID EEPROM for the specified field replaceable unit (FRU) cannot be read; FRU-ID data might not be programmed. FRU-ID data includes the worldwide name, SCSI ID, and branding information.	A service technician can reprogram FRU-ID data.
248	Informational	A valid feature license was successfully installed. See event 249 for details about each licensed feature.	
249	Informational	A valid license has been installed for the specified feature. This event is logged for each licensed feature to show the new license value for that feature.	
250	Warning	A license could not be installed (license is invalid).	Check license parameters against what is allowed for the platform and recreate the license using valid parameters, then reinstall.  Review the readme file that came with the license.
251	Warning	A volume-copy operation has started for the specified source volume.	
252	Informational	Snapshot write data on the specified master volume has been deleted.	
256	Informational	The specified snapshot has been created but not committed. A commit action is required before the snapshot can be used.	
257	Informational	The specified snapshot has been created and committed.	
258	Informational	The specified snapshot has been committed and is ready for use.	
259	Informational	In-band CAPI commands have been disabled.	
260	Informational	In-band CAPI commands have been enabled.	
261	Informational	In-band SES commands have been disabled.	
262	Informational	In-band SES commands have been enabled.	
263	Warning	The specified disk spare is missing. It was either removed or is not responding.	Replace the specified disk.
264	Informational	The link speed of the port bypass circuit and interconnect mode has been set to the default.	

**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
265	Informational	Port bypass circuits currently use the service port, which may limit the link speed or interconnect mode support.	Perform a system-level shutdown and restart. Note that this will cause all data to be unavailable for about 1 minute.
266	Informational	A copy operation for the specified master volume has been aborted.	
268	Informational	A background copy operation for the specified master volume completed.	
269	Informational	A partner firmware update operation has started. This operation is used to copy firmware from one controller to the other to bring both controllers up to the same version of firmware.	
270	Warning	There is a problem reading or writing the persistent IP data from the FRU-ID SEEPROM, or if invalid data is read from the FRU-ID SEEPROM.	Check the IP settings (including iSCSI host channel IP data for an iSCSI system), and update them if they are incorrect.
271	Informational	System could not get a valid serial number from the controller's FRU-ID SEEPROM, either because it couldn't read the FRU-ID data, or because the data on it isn't valid or hasn't been programmed. Therefore, the MAC address is derived by using the controller's serial number from flash. This event is only logged one time during bootup.	
272	Informational	The snap pool is being expanded.	
273	Informational	Fault isolation has been enabled or disabled for the specified enclosure and controller within that enclosure.	
274	Informational	A phy has been disabled.	
275	Informational	A phy has been enabled.	
298	Warning	The controller's real-time clock (RTC) settings might be invalid after an unexpected power loss.	Check the system date and time. If either is incorrect, set them to the correct date and time.
299	Informational	The controller's real-time clock (RTC) settings were recovered after an unexpected power loss.	
300	Informational	CPU frequency has been adjusted to high.	
301	Informational	CPU frequency has been adjusted to low.	
302	Informational	DDR memory clock has been adjusted to high.	
303	Informational	DDR memory clock has been adjusted to low.	
304	Informational	The controller has detected I <sup>2</sup> C errors that may have been fully recovered. This event is logged as informational to note an existence of previous I <sup>2</sup> C errors.	
305	Informational	A serial number in SC flash memory is invalid. The valid serial number will be recovered automatically.	

**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
306	Informational	An old serial number in SC flash memory has been updated to a new serial number.	
307	Critical	A temperature sensor on a controller FRU detected an over-temperature condition that caused the controller to shut down.	<p>Check that the storage system's fans are running.</p> <p>Check that the ambient temperature is not too warm. The enclosure operating range is 41–104° F (5–40° C).</p> <p>Check for any obstructions to the airflow.</p> <p>If none of the above explanations apply, replace the controller FRU that reported the error.</p>
308	Informational	The default host port speed has changed from 4 Gbit/sec to 2 Gbit/sec because the controller module's HIM has a Broadcom PBC.	
309	Informational	Normally when the MC is started, the IP data is obtained from the SEEPROM where it is persisted. If the system is unable to write it to the SEEPROM the last time it changed, a flag is set in flash memory. This flag is set during startup, and if set, this event is logged and the IP data that is in flash memory is used. The only time that this would not be the correct IP data would be if the controller board was swapped and then whatever data is on the board's flash memory is used.	
310	Informational	After a rescan, the controller completed back-end discovery and initialization of enclosure data.	
313	Critical	An I/O module is down and will not be automatically restarted. This only applies when the other SC goes down.	The SC needs service or replacement.
314	Critical	A FRU has failed or is not operating correctly. This event follows some other FRU specific event indicating a problem.	Examine the FRU specified in the message to determine whether it needs to be replaced.
315	Critical	The controller module is incompatible with the enclosure. The controller will automatically shut down. If two incompatible controllers are inserted at the same time, or booted at the same time, one controller will crash and the other will hang. This behavior is expected and prevents data loss.	Move the controller module to a compatible controller.
316	Informational or warning	The temporary license for a feature is about to expire or has expired. This event is logged as informational while time remaining in the trial period is nonzero. This event is logged as a warning when the trial period expires.	To continue using the feature after the trial period, purchase a permanent license.

**Table 14** Event code descriptions and recommended actions (continued)

Event code	Event type	Description	Recommended action
322	Warning	<p>The controller has an older SC version than the version used to create the CHAP authentication database in the controller's flash memory.</p> <p>The CHAP database cannot be read or updated. However, new records can be added, which will replace the existing database with a new database using the latest known version number.</p>	<p>Upgrade to an SC version that is current for the indicated database version.</p> <ul style="list-style-type: none"> <li>• If no records were added, the database becomes accessible and remains intact.</li> <li>• If records were added, the database becomes accessible but contains only the new records.</li> </ul>
352	Informational	EC assert data or stack-dump data is accessible.	
353	Informational	EC assert data and stack-dump data have been cleared.	
354	Informational or warning	SAS topology has changed on a host port. For example, the SAS cable connecting a controller host port to a host has been disconnected. This event is logged as informational for a topology change where at least one PHY goes "up." This event is logged as a warning for a topology change where at least one PHY goes "down."	
355	Warning	The faceplate's debug button was found to be stuck in the On position during boot up.	
412	Warning	One disk in the specified RAID-6 vdisk failed. The vdisk is operational with Degraded health and status FTDN (fault tolerant with a down disk).	Replace the down disk with a spare so the system can start reconstructing the vdisk.
443	Warning	A firmware version mismatch has been detected in an MSA70 drive enclosure. The enclosure should be updated to the latest supported version of firmware as soon as possible.	In the drive enclosure all FRUs (I/O module, fan, power supply, midplane, backplane, and 7-segment LED) must be at a combined proper firmware recipe. The two I/O modules must be at equal firmware versions. Any replaced MSA70 FRUs might have older firmware that does not match an internally defined recipe. Update the drive enclosure to the latest firmware version to ensure all FRUs are at the proper firmware level.



As referred to in [Table 14](#), the following table lists disk- error conditions and recommended actions.

**Table 15** Disk error conditions and recommended actions

Status	Recommended action
The status of the vdisk that originally had the failed disk status is Good. A global or vdisk (dedicated) spare has been successfully integrated into the vdisk and the replacement disk can be assigned as either a global spare or a vdisk spare.	Use SMU to assign the new disk as either a global spare or a vdisk spare.
The status of the disk just installed is LEFTOVER.	All of the member disks in a vdisk contain metadata in the first sectors. The storage system uses the metadata to identify vdisk members after restarting or replacing enclosures.  Use SMU to clear the metadata if you have a disk that was previously a member of a vdisk. After you clear the metadata, you can use the disk in a vdisk or as a spare.
If the status of the vdisk that originally had the failed disk status is FATAL FAIL, two or more disks have failed.	All data in the vdisk is lost. Use the SMU Trust Vdisk function to attempt to bring the vdisk back online.
The status of the vdisk that originally had the failed disk status is DRV ABSENT or INCOMPLETE. These status indicators only occur when the enclosure is initially powered up. DRV ABSENT indicates that one disk is bad. INCOMPLETE indicates that two or more disks are bad.	Make sure the enclosures and associated data host were powered on in this order: first the drive enclosures, then the controller enclosure, then the data host. If the power-on sequence was correct, locate and replace the additional failed disks.
The status of the vdisk that originally had the failed disk indicates that the vdisk is being rebuilt.	Wait for the vdisk to complete its operation.
The status of the vdisk that originally had the failed disk is DRV FAILED.	If this status occurs after you replace a defective disk with a known good disk, the enclosure midplane might have experienced a failure. Replace the enclosure.

As referred to in [Table 14](#), the following table lists power supply module faults and recommended actions.

**Table 16** Power supply faults and recommended actions

Fault	Recommended action
Power supply fan warning or failure, or power supply warning or failure. Event code 168.	<ul style="list-style-type: none"> <li>• Check that all of the fans are working using SMU.</li> <li>• Make sure that no slots are left open for more than 2 minutes. If you need to replace a module, leave the old module in place until you have the replacement, or use a blank cover to close the slot. Leaving a slot open negatively affects the airflow and might cause the unit to overheat.</li> <li>• Make sure that the controller modules are properly seated in their slots and that their latches are locked.</li> </ul>
Power supply module status is listed as failed or you receive a voltage event notification. Event code 168.	<ul style="list-style-type: none"> <li>• Check that the switch on each power supply module is turned on.</li> <li>• Check that the power cables are firmly plugged into both power supply and into an appropriate electrical outlet.</li> <li>• Replace the power supply module.</li> </ul>
Power LED is off.	Same as above.
DC Voltage/Fan Fault/Service Required LED is on.	Replace the power supply module.



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## C Using FTP to download logs and update firmware

Although SMU is the preferred interface for downloading logs, updating firmware, and installing a license, you can also use FTP to do these tasks.

### Downloading system logs

To help service personnel diagnose a system problem, you might be asked to download and submit system log data. You can do this by accessing the system's FTP interface and running the `get logs` command. When both controllers are online, regardless of operating mode, `get logs` will download the following data into a single file:

- User configuration settings from both controllers
- Event logs from both controllers
- SC debug logs from both controllers
- SC crash dumps from both controllers
- MC CAPI trace from the target controller
- MC debug log from the target controller
- Controller environment (including data about attached disks, enclosures, and so forth)

It is recommended to use a command-line-based FTP client. A GUI-based FTP client might not work.

#### To download logs to a file

1. In SMU, prepare to use FTP:
  - a. Determine the network-port IP addresses of the system's controllers.
  - b. Verify that the system's FTP service is enabled.
  - c. Verify that the user you will log in as has permission to use the FTP interface.
2. Open a Command Prompt (Windows) or a terminal window (UNIX) and navigate to the destination directory for the log file.
3. Enter:

```
ftp controller-network-address
```

For example:

```
ftp 10.1.0.9
```
4. Log in as an FTP user.
5. Enter:

```
get logs filename.txt
```

where *filename* is recommended to be *yyyymmdd\_ftp\_system-name\_controller-ID*. For example:

```
get logs 20080124_ftp_Storage2_A.txt
```

Wait for the message `Transfer complete` to appear.
6. Quit the FTP session.
7. If the problem to diagnose seems specific to user-interface operation (e.g., SMU or CLI crashes or hangs), repeat [step 3](#) through [step 6](#) on the partner controller to collect its unique MC debug information.

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**NOTE:** Log files can exceed 5 MB. Before sending a log file to service personnel or attaching it to a bug-tracking system, you should compress the file with a tool whose output is compatible with WinZip.

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## Updating controller module firmware

A controller enclosure can contain one or two controller modules. In a dual-controller system, both controllers should run the same firmware version. You can update the firmware in each controller module by loading a firmware file obtained from the HP web download site, <http://www.hp.com/go/msa>. To install an HP ROM Flash Component or firmware Smart Component, follow the instructions on the HP web site; otherwise, to install a firmware binary file, follow the steps below.

If you have a dual-controller system and the Partner Firmware Update option is enabled, when you update one controller the system automatically updates the partner controller. If Partner Firmware Update is disabled, after updating software on one controller you must manually update the partner controller.

### To update controller module firmware

1. Obtain the appropriate firmware file and download it to your computer or network.
2. In SMU, prepare to use FTP:
  - a. Determine the network-port IP addresses of the system's controllers.
  - b. Verify that the system's FTP service is enabled.
  - c. Verify that the user you will log in as has permission to use the FTP interface.
3. If the system has a single controller, stop I/O to vdisks before starting the firmware update.
4. Open a Command Prompt (Windows) or a terminal window (UNIX) and navigate to the directory containing the firmware file to load.
5. Enter:

```
ftp controller-network-address
```

For example:

```
ftp 10.1.0.9
```

6. Log in as an FTP user.

7. Enter:


```
put firmware-file flash
```

For example:

```
put mercurysw-M100P01-01.bin flash
```


It takes approximately 10 minutes for the firmware to load and for the automatic restart to complete on the controller you are connected to. Wait for progress messages to specify that the update has completed. If Partner Firmware Update is enabled, allow an additional 20 minutes for the partner controller to be updated. No messages are displayed in the FTP interface while the partner is being updated.

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 **WARNING!** Do not perform a power cycle or controller restart during a firmware update. If the update is interrupted or there is a power failure, the module might become inoperative. If this occurs, contact technical support. The module might need to be returned to the factory for reprogramming.

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 **NOTE:** If you attempt to load an incompatible firmware version, the message `***Code Load Fail. Bad format image.***` is displayed and after a few seconds the FTP prompt is redisplayed. The code is not loaded.

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## Updating expansion module firmware

A drive enclosure can contain one or two expansion modules. Each expansion module contains an enclosure management processor (EMP). All modules of the same model should run the same firmware version. You can update the firmware in each expansion module by loading a firmware file obtained from the HP web download site, <http://www.hp.com/go/msa>. To install an HP ROM Flash Component or firmware Smart Component, follow the instructions on the HP web site; otherwise, to install a firmware binary file, follow the steps below.

### To update expansion module firmware

1. Obtain the appropriate firmware file and download it to your computer or network.
2. In SMU, determine the address of each expansion module to update:
  - a. In the Configuration View panel, select a drive enclosure.
  - b. In the enclosure properties table, note each EMP's bus ID and target ID values. For example, 0 and 63, and 1 and 63. Bus 0 is the bus that is native to a given controller, while bus 1 is an alternate path through the partner controller. It is recommended to perform update tasks consistently through one controller to avoid confusion.
3. In SMU, prepare to use FTP:
  - a. Determine the network-port IP addresses of the system's controllers.
  - b. Verify that the system's FTP service is enabled.
  - c. Verify that the user you will log in as has permission to use the FTP interface.
4. Stop I/O to vdisks before starting the firmware update.
5. Open a Command Prompt (Windows) or a terminal window (UNIX) and navigate to the directory containing the firmware file to load.

6. Enter:

```
ftp controller-network-address
```

For example:

```
ftp 10.1.0.9
```

7. Log in as an FTP user.

8. Enter:

```
put firmware-file encl:EMP-bus-ID:EMP-target-ID
```

For example:

```
put mercurysw-M100P01-01.bin encl:1:63
```

It typically takes 6.5 minutes to update an EMP in each MSA70 drive enclosure, or 1.5 minutes to load an EMP in each MSA2000 12-drive enclosure. Wait for progress messages to specify that the update has completed.

---

**⚠ WARNING!** Do not perform a power cycle or controller restart during the firmware update. If the update is interrupted or there is a power failure, the module might become inoperative. If this occurs, contact technical support. The module might need to be returned to the factory for reprogramming.

---

9. Repeat [step 8](#) for each remaining expansion module that needs to be updated.
10. If you updated firmware in an HP MSA70 drive enclosure, power cycle the enclosure to complete the update process.
11. In SMU, verify that the proper firmware version appears for each updated expansion module.

## Updating disk firmware

You can update disk firmware by loading a firmware file obtained from the HP web download site, <http://www.hp.com/go/msg>, or from the disk manufacturer. To install an HP ROM Flash Component or firmware Smart Component, follow the instructions on the HP web site; otherwise, to install a firmware binary file, follow the steps below.

A dual-ported disk can be updated from either controller. A single-ported disk that is in a vdisk or is a dedicated spare for a vdisk must be updated from the controller that owns the vdisk. Attempting to update a single-ported disk from the non-owning controller will not cause any change to the disk.

Disks in single-ported MSA70 drive enclosures must be updated from the controller to which the MSA70 is connected.

---

 **NOTE:** Disks of the same model in the storage system must have the same firmware revision.

---

### To prepare for update

1. Obtain the appropriate firmware file and download it to your computer or network.
2. Check the disk manufacturer's documentation to determine whether disks must be power cycled after firmware update.
3. In SMU, for each disk to update:
  - a. Determine the enclosure number and slot number of the disk.
  - b. If the disk is SATA and is associated with a vdisk, determine which controller owns the vdisk.
4. In SMU, prepare to use FTP and the CLI:
  - a. Determine the network-port IP addresses of the system's controllers.
  - b. Verify that the system's FTP and CLI services are enabled.
  - c. Verify that the user you will log in as has permission to use the FTP and CLI interfaces.
5. Stop I/O to the storage system. During the update all volumes will be temporarily inaccessible to hosts. If I/O is not stopped, mapped hosts will report I/O errors. Volume access is restored after the update completes.

### To update disk firmware

1. Open a Command Prompt (Windows) or a terminal window (UNIX) and navigate to the directory containing the firmware file to load.

2. Enter:

```
ftp controller-network-address
```

For example:

```
ftp 10.1.0.9
```

3. Log in as an FTP user.

4. Enter:

```
put firmware-file disk:enclosure-ID:slot-number
```


For example:

```
put 90-00000178.bin disk:1:11
```

It typically takes several minutes for the firmware to load. Wait for progress messages to specify that the update has completed (passed); for example:

```
ftpdProcessStor: DIM_UpdateDevice drive at enclosure = 1 slot = 11 passed
```

---


 **WARNING!** Do not power cycle enclosures or restart a controller during the firmware update. If the update is interrupted or there is a power failure, the disk might become inoperative. If this occurs, contact technical support.

---

5. Repeat [step 4](#) for each disk to update.

6. Quit the FTP session.
7. If the updated disks must be power cycled:
  - a. Shut down both controllers by using SMU.
  - b. Power cycle all enclosures as described in your product's user guide.

---

 **NOTE:** If you loaded firmware to a Seagate 750-Gbyte Barracuda ES SATA drive, after spin-up it will be busy for about 50 seconds completing its upgrade. Then it will be ready for host I/O.

---

8. In SMU, verify that each disk has the correct firmware revision.
9. Resume host I/O.

## Installing a license file

1. Ensure that the license file is saved to a network location that the storage system can access.
2. Open a Command Prompt (Windows) or a terminal window (UNIX) and navigate to the directory containing the firmware file to load.
3. Log in to the controller enclosure that the file was generated for:

```
ftp controller-network-address
```

For example:

```
ftp 10.1.0.9
```

4. Log in as an FTP user.
5. Enter:

```
put license-file license
```

For example:

```
put certificate.txt license
```

A message confirms whether installation succeeded or failed. If installation succeeds, licensing changes take effect immediately.





---

# Glossary

<b>CHAP</b>	Challenge-Handshake Authentication Protocol.
<b>chunk size</b>	The amount of contiguous data that is written to a vdisk member before moving to the next member of the vdisk.
<b>dedicated spare</b>	A disk that is reserved for use by a specific vdisk to replace a failed disk.
<b>default mapping</b>	Host-access settings that are configured when a volume is created.
<b>dual-port disk</b>	A dual-port disk is connected to both controllers so its data path is fault tolerant.
<b>dynamic spare</b>	A properly sized available disk that is automatically assigned, if the dynamic spares option is enabled, to replace a failed disk in a redundant vdisk.
<b>EC</b>	Expander Controller. The processor (located in the SAS expander in each controller module and expansion module) that is primarily responsible for enclosure management and SES.
<b>EMP</b>	Enclosure management processor. An EC subsystem that provides SES data such as temperature, power supply and fan status, and the presence or absence of disks.
<b>FC</b>	Fibre Channel interface protocol.
<b>global spare</b>	A disk that is reserved for use by any redundant vdisk to replace a failed disk.
<b>host</b>	An external port that the storage system is attached to. The external port may be a port in an I/O adapter in a server, or a port in a network switch.
<b>IQN</b>	iSCSI Qualified Name.
<b>iSCSI</b>	Internet SCSI interface protocol.
<b>iSNS</b>	Internet Storage Name Service.
<b>jumbo frame</b>	In an iSCSI network, a frame that can contain 9000 bytes for large data transfers. A normal frame can contain 1500 bytes.
<b>leftover</b>	The state of a disk when its metadata says the disk is a member of a vdisk but other members' metadata say the disk isn't a member. The metadata must be cleared before the disk can be used in a new vdisk or as a spare.
<b>loop</b>	Fibre Channel Arbitrated Loop (FC-AL) topology.
<b>masking</b>	Volume-mapping settings that specify no access to that volume by hosts.
<b>master volume</b>	A volume that is enabled for snapshots and has an associated snap pool.
<b>MC</b>	Management Controller. The processor (located in a controller module) that is primarily responsible for human-computer interface and computer-computer interface functions, and interacts with the SC.
<b>metadata</b>	Data in the first sectors of a disk drive that stores all disk, vdisk, and volume specific information including vdisk membership or spare identification, vdisk ownership, volumes and snapshots in the vdisk, host mapping of volumes, and results of the last media scrub.
<b>network port</b>	The Ethernet port on a controller module through which its Management Controller is connected to the network.
<b>point-to-point</b>	Fibre Channel Point-to-Point topology.
<b>SAS</b>	Serial Attached SCSI interface protocol or disk-drive architecture.
<b>SATA</b>	Serial ATA disk-drive architecture.
<b>SC</b>	Storage Controller. The processor (located in a controller module) that is primarily responsible for RAID controller functions. The SC is also referred to as the RAID controller.
<b>secret</b>	For use with CHAP, a password that is shared between an initiator and a target to enable authentication.
<b>SES</b>	SCSI Enclosure Services.
<b>single-port disk</b>	A single-port disk is connected to both controllers so its data path is not fault tolerant. A single-port disk's type is shown as SAS-S or SATA-S.

<b>snap pool</b>	A volume that stores data that is specific to snapshots of an associated master volume, including copy-on-write data and data written explicitly to the snapshots. A snap pool cannot be mapped.
<b>snapshot</b>	A “virtual” volume that preserves the state of a master volume’s data as it existed when the snapshot was created. Data associated with a snapshot is recorded in both the master volume and in its associated snap pool. A snapshot can be mapped and written to.
<b>SSD</b>	Solid-state drive. Supported SSDs have a SATA interface.
<b>ULP</b>	Unified LUN Presentation. A RAID controller feature that enables a host to access mapped volumes through any controller host port.
<b>unwritable cache data</b>	Cache data that has not been written to disk and is associated with a volume that no longer exists or whose disks are not online. If the data is needed, the volume's disks must be brought online. If the data is not needed it can be cleared, in which case it will be lost and data will differ between the host and disk. Unwritable cache is also called orphan data.
<b>vdisk</b>	A “virtual” disk comprising the capacity of one or more disks. The number of disks that a vdisk can contain is determined by its RAID level.
<b>volume</b>	A portion of the capacity of a vdisk that can be presented as a storage device to a host.
<b>volume copy</b>	Licensed capability to create a copy of (clone) a volume.
<b>WWN</b>	World Wide Name. A globally unique 64-bit number that identifies a node process or node port.
<b>WWNN</b>	World Wide Node Name. A globally unique 64-bit number that identifies a node process.
<b>WWPN</b>	World Wide Port Name. A globally unique 64-bit number that identifies a node port.

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